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GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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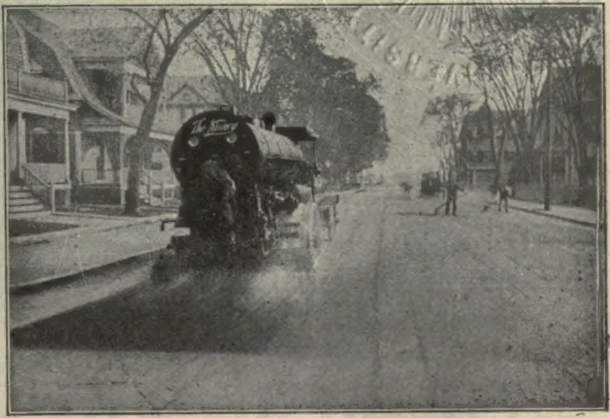

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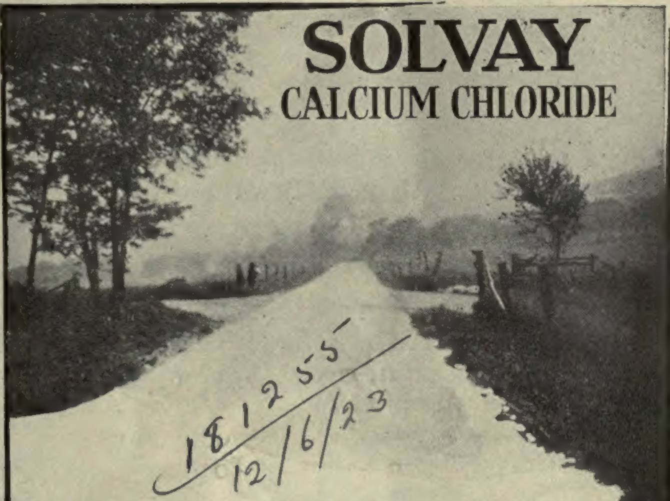

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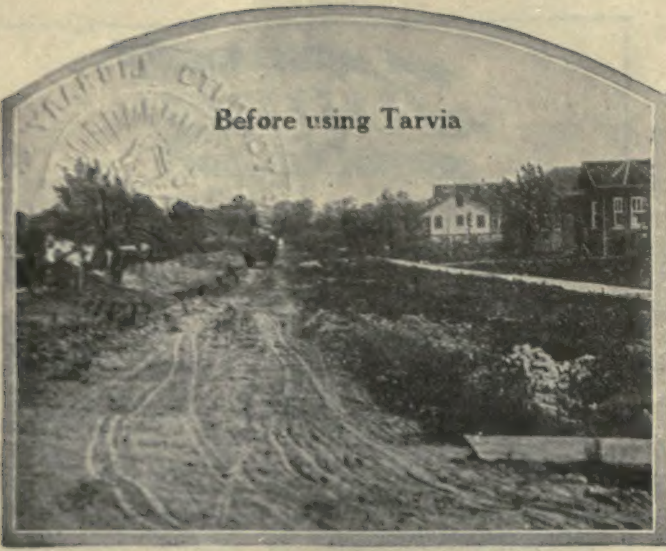
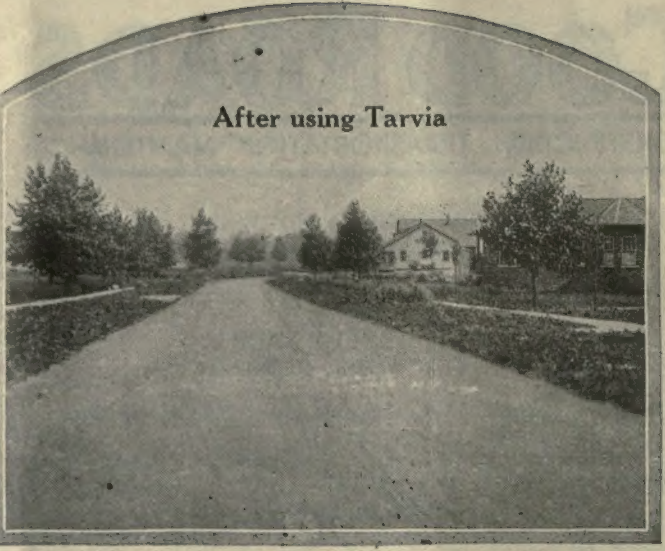


Wretched condition of Kenilworth Avenue, Villa Park, Ill., before the use of Tarvia



Picture of same section after being constructed with "Tarvia-X." Note excellent condition of road today

Good Roads Boost Property Values—

YOU can easily see how Tarvia has improved property values along Kenilworth Avenue, Villa Park, a pretty suburb of Chicago, Ill.

Here was a stretch of road that was bumpy and "hard going" on even the best of days, while during the Spring thaw and after a heavy rain, it was practically impossible to navigate.

That was its condition before the road authorities of Villa Park turned to Tarvia. Tarvia will make this road last for years. With but occasional inexpensive treatments with "Tarvia-B" as the traffic demands it, it will always be free from mud and dust, waterproof, frost-proof and traffic-proof. It has increased the desirability of the abutting property many hundred per cent.

For these reasons Tarvia streets have the hearty approval of taxpayers everywhere. The story of Kenilworth Avenue is being repeated in many cities and towns all over the country.

Tarvia is a coal-tar preparation for use in constructing new macadam roads or repairing old ones. One Tarvia road in your community will prove to you and your townspeople how Tarvia roads increase property values and decrease taxes.

Illustrated booklet telling about the various Tarvia treatments free on request.

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This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by any one interested. If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will be given prompt attention.

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GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

WITH WHICH IS INCORPORATED

THE HIGHWAY CONTRACTOR AND ROAD BUILDER

Vol. LXI. NEW YORK, N. Y., JULY 6, 1921 Number 1

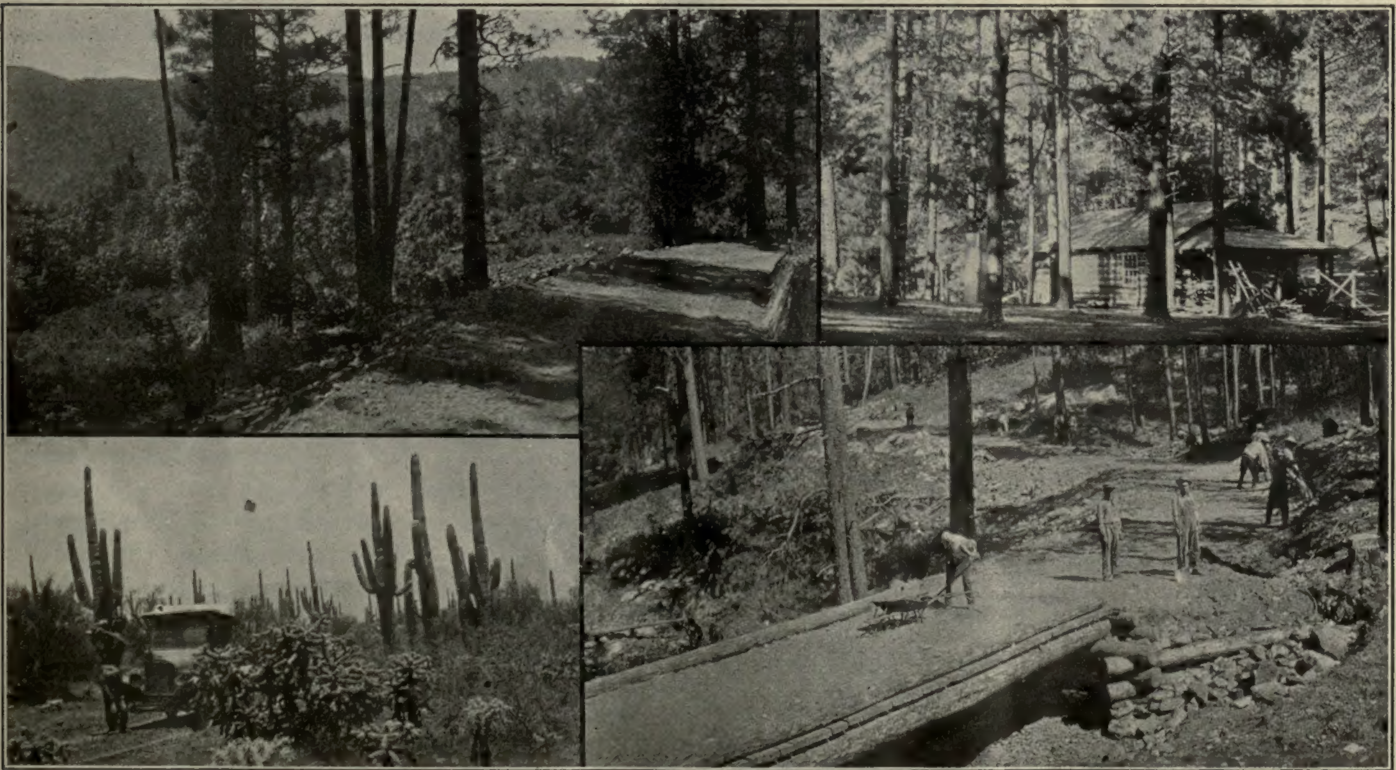
New Forest Road Completed In Arizona

Highway from Oracle to Summit of Catalinas in Coronado National Forest Provides Automobile Drive of Remarkable Scenic Beauty and Affords Transportation Facilities for Several Promising Mines.

An automobile highway from a point near Oracle, Ariz., on the main county highway, to the summit of the Catalina Range in the Coronado National Forest has been completed and opened to traffic.

The road is 23 mi. long, 12 ft. wide and has a maximum grade of 8%. It was built under the supervision of engineers of the U. S. Bureau of Public Roads, as a forest project, the cost being borne partly by the federal appropriation for the improvement of roads and trails in the national forests. The total cost was $235,000, of which the Forest Service supplied $124,000 and Pima and Pinal Counties $91,000 and $20,000, respectively.

The construction of the road makes the summit of the range, a region of dense forests, beautiful scenery and a delightful summer climate, accessible



NEW AUTOMOBILE ROAD UP THE CATALINA MOUNTAINS IN THE CORONADO NATIONAL FOREST

Upper Left: A View of the New Apache-Soldier Camp Road—Upper Right: The Soldier Camp Ranger Station at the Summit of the Catalinas—Lower Left: The Giant Cactus Forest in the Coronado National Forest near Oracle. This is one of the largest Cactus Forests in the Southwest—Lower Right: The Apache-Soldier Camp Road During its Construction in 1920.

to the residents of Tucson and other communities in Pima and Pinal Counties. Previous to the opening of the road, the mountains could be reached only by an arduous trip by pack trail. The top of the range offers a considerable expanse of comparatively level ground admirably suited to the building of summer places and work has been started on a number of dwellings.

Besides opening up the mountain playground, the road will be of considerable use to several promising mines along the route and to the Forest Service in fire protection and the development of forest resources.

Dimensions, Weights and Speeds of Motor Trucks*

Committee of National Highway Traffic Association Makes Unanimous Report at Annual Meeting

Your Committee has definitely and unanimously determined on the following:

Width ....96 in., extreme dimensions
Height ....12 ft. 6 in., extreme dimensions
Length ....30 ft. extreme dimensions

Solid rubber tires, 800 lb. per inch of tire width, measured at base of the rubber.

Maximum axle loading, 22,000 lb.

There was a diversity of opinion among the members of the Committee as to the maximum weight permissible, and when the various opinions were submitted to the annual convention in Detroit on April 29, 1921, the convention, by a very large majority, expressed an opinion of 28,000 lb. maximum weight limitation. Therefore, 28,000 lb. will be considered as the maximum weight limitation hereafter.

It was suggested at the convention that the following speeds be submitted, the reason for these changes being that the refinement of 18 and 16 mi. an hour seem unnecessary and impractical of enforcement.

Weights (lb., gross)	Speeds (Miles per hour)	
	Country	City
4,000	25	20
8,000	20	20
12,000	20	15
16,000	15	15
20,000	15	15
24,000	15	15
28,000	15	15

Your Committee wishes to make no suggestions concerning speeds of trucks when equipped with pneumatic tires, because the members of the Committee do not feel that they have been able to accumulate sufficient data to enable them to make any definite recommendations.

Your Committee makes no suggestions concerning trailers, for a similar reason.

Road Conditions on the Lincoln Highway Better than Ever

Route Far From Completion but in Better Condition This Year Than Ever Before In Its History

Road conditions on the Lincoln Highway are better this year than they have ever been in the past and, while the road is not completed from coast to coast, that fact "need not deter the seasoned motorist from undertaking a trip which has come to be looked upon as 'the great American tour,'" according to a recent statement from the headquarters of the Lincoln Highway Association.

The Lincoln Highway extends from New York City to San Francisco and is 3,305 mi. long. The association has been promoting its improvement for the past eight years, during which time over $31,000,000 has been spent by the Federal Government, the states and the counties along the route in improving the roads that comprise it. A somewhat detailed resume of present road conditions is given in the statement to which reference has been made, and in which the highway is characterized as "the backbone of a national highway system—the Main Street of America."

In general, the road is in good condition, but there are sections that will present difficulty, especially in bad weather and the association suggests that "No one should undertake a transcontinental trip this year without first inquiring from the headquarters of the Lincoln Highway Association in Detroit as to the condition of those sections of the route which it is proposed to drive."

The first leg of the trip, the 65-mi. drive across New Jersey, is better than ever before, it is stated, "the highest type of concrete construction upon the Lincoln Highway at any point between the two coasts," being in that state.

The Pennsylvania section is described as well maintained macadam. The route is closed between Chambersburg and Gettysburg during reconstruction, and minor detours may be encountered at other places.

Across Ohio, Indiana and Illinois great progress has been made, some long stretches of concrete and considerable sections of brick paving being the principal hard surfaces. From Chicago to the Mississippi River there is concrete.

West of the Mississippi there is little pavement until the route enters California. Much of the mileage in Iowa is well graveled and nearly all of the route is well graded and drained. This section is described as "a dry weather boulevard, but a route which, in the event of heavy rain, on its graded dirt sections will offer some difficulties and inconveniences to travel." It is recommended that the tourist wait for the roads to dry both in Iowa and

(Concluded on page 8)

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*Report of the National Committee on Regulations Covering Speeds, Weights and Dimensions of Motor Trucks, presented at the annual meeting of the National Highway Traffic Association, New York, N. Y., May 13, 1921.

Presented by George H. Pride, President, Heavy Haulage Co., New York, N. Y., Chairman.

Brick Pavement Design *

Determination of Pavement Type Should be Governed by Local Conditions — Limitations of Vitrified Brick as Paving Material—Factors in Determination of Type—Standard Practice in Brick Paving—Kinds of Brick Blocks.

By JAMES C. TRAVILLA†

The different types of pavements now recognized by highway engineers have their respective places. The adoption of a particular type should be governed by local conditions, for no pavement is adapted to universal use, regardless of occasional statements to the contrary.

Vitrified paving brick has its limitations. The proper raw material is not available everywhere, nor is the total output sufficient to cover a large yardage, as compared with the total area paved each year.

Many of the older brick pavements demonstrate the ability of brick to withstand abrasion and impact, for it is not unusual to find pavements of this type that have furnished satisfactory wearing surfaces for 25 years or longer. Such service tests merit consideration by engineers. Brick seldom wears out from abrasion and most of the failures of brick pavement are due to insufficient bearing power of the subgrade, to inadequate foundation, or to shifting or settlement of the sand cushion or bedding course.

A preliminary study for the determination of the type of pavement to build should include consideration of present and probable future traffic, the availability of materials of construction, grades, drainage, subsoil conditions, climate, taxability of benefitted property, and cost.

Engineers are departing from a so-called standard design of brick pavement because of the different artificial foundations and joint fillers available. The designs described in the following paragraphs conform to good engineering practice.

The so-called monolithic design provides for a pavement that is rigid throughout. The blocks are laid upon the green concrete foundation or upon an added cement-sand film, and the joints are filled with a rich mixture of sand, cement and water. This grout is applied at the consistency of thin cream, after the bricks have been sprinkled thoroughly to temper the bedding course and to strengthen the bond between the filler and the bricks. The special merits of this design are that the pavement sets as a unit and the cost of concrete curb or edging is saved. A large amount of this type has been laid in Ohio, Indiana and Illinois, generally with 4-in blocks on a 4-in. cement concrete foundation.

The semi-monolithic design is a modification of the monolithic and is preferred for pavements over 20 ft. wide, as it is difficult to draw the cutting template over the green concrete foundation without developing unevenness. In this type the concrete foundation is allowed to set before the bedding course of dry cement and sand is put down.

The cost of either of these types depends upon the proximity of the material supply and upon labor costs. Under existing conditions it varies from $3.50 to $4.50 per square yard.

In either of these designs it may be desirable to provide for temperature stresses, and the placing of a transverse expansion joint at the end of a day's run, with others at the tangent points of vertical curves, is generally sufficient. Most troubles from temperature stresses are due to structural defects. For instance, a slanting joint at the end of a run may cause the pavement to "blow up." Defective spots will occur when the filler bridges joints. In this connection it should be noted that the consistency of the grout filler is a most important detail, for it should fill the joints to the full depth of the brick. If it does not, temperature stresses are not uniformly distributed to the blocks and they may shear off at the top.

Monolithic and semi-monolithic pavements may develop longitudinal cracks when the subgrade is a heavy clay. These result from the expansion of the subsoil caused by the infiltration of water and by frost action. Their prevention is a matter of drainage and soil treatment. Placing a 4-in. bed of cinders on a heavy clay subgrade will aid in preventing such cracks. If cinders are not available, top soil or sand may be mixed with the clay to increase its bearing power and lower its capillarity.

Bituminous joint filler permits the individual blocks to adjust themselves to the natural forces that tend to cause blowing up and cracking in rigid pavements.

The artificial foundation for a brick pavement with bituminous filler may be of Portland cement concrete, bituminous macadam, rolled stone, or a mixture of sand and clay. The bedding course may be a mixture of cement and sand, a mixture of bitumen and sand, stone screenings, or sand. Mixing cement or bitumen with the sand prevents the sand particles from shifting or rolling, so helping to maintain a true contour.

(Concluded on page 8)

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*Abstract of a paper entitled "Brick Paved Roads," presented at a meeting of the Kentucky Highway Engineers' Association, Louisville, Ky., June 7-10, 1921.

†Consulting Engineer, the Dunn Wire-Cut Lug Brick Co., St. Louis, Mo.

The Distribution of Highway Costs[*]

Principles Involved in the Sound Investment of Capital—Analysis of Benefits Accruing from Road Betterments—Distinction Between Construction and Maintenance Costs—Conclusion

In making this final report the Committee realizes that the subject matter of the report is such as can not properly be touched upon lightly. The Committee believes the proper analysis and just distribution of the cost of construction and maintenance of state highways is one of the most important economical principles in the science of highway improvement. Capital in large amount must be secured with which to construct and maintain public thoroughfares, and these thoroughfares must justify this use of billions of capital by supplying an economic need to the investor in proportion to the amount invested. This final report is submitted with the hope that the Association will see fit to continue a committee investigation.

Principles Involved

The application of principles of sound investment of capital in various enterprises will necessarily vary according to the state of development of the industry in which the investment is made, but the underlying principles of sound investments are narrowly defined and well recognized.

1. The justification of the investment of capital in an enterprise is that the net economic return which comes to the investor in the form of all benefits derived from the use of the enterprise, is sufficient to reimburse the investor for the original capital plus a reasonable amount for the use of the capital invested, during the service life of the enterprise.

2. The underlying principles of cooperative investments is that a just division of returns is that which makes the return directly proportional to the capital invested. Or applying this same ratio inversely, a just distribution of costs must be directly proportional to the benefits derived.

Because of the total lack of uniformity among the various states of distributing highway costs, the policies varying from a state which has placed the total cost of the original investment in highways on automotive vehicles, to other states which almost ignore this source of revenue, the committee feels it necessary to accept the above commonly recognized principles of investment as the fundamentals on which to build an analysis.

Analysis of Benefits

Many of the benefits derived from the improvement of highways are so obvious that it is only necessary to enumerate them. The following is a list which might be further subdivided but need not be for the purpose of this report:

1. Development of commerce.
2. Development of industries.
3. Development of agriculture.
4. Development of natural resources.
5. Development of rural schools and churches.
6. Development of general intellectual and social life.
7. Improved appearance of roads.
8. Permanency of aligniment and grade of highways.
9. Decrease in cost of transportation.
10. Development of methods of transportation.
11. Facility of travel.
12. Increase of land values.
13. Development of economic specialization.
14. Development of back-to-the-farm movement.
15. Development of national power.

The above are benefits, all of which encouraged the improvement of highways before there were automotive vehicles, and many of which have been recognized and considered adequate justification for the improvement of highways from two thousand years ago up to the present time. A realization of the inherent value of many of these benefits resulted in the development of state aid policies in New Jersey in 1891, and in Massachusetts in 1893, and several other states long before the motor vehicle had become a factor in highway traffic.

The development of tourist travel is a benefit which the committee treats separately because of the division of opinion in its regard. It is certainly a benefit resulting from highway improvement, which gives a net economic return, and the beneficiaries of the return should account for their portion of the capital required to make the benefit possible. The principal beneficiary, however, is the community being toured, where the tourist spends his money, and no proof of this is more conclusive than the open recognition of this fact by all communities, expressed in their every attempt to encourage tourists to enter their territory.

The analysis of the development of motor truck traffic shows that it is a benefit resulting from the

(Concluded on page 8)

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[*] Report of the National Committee on Equitable Distribution of the Cost of Construction and Maintenance of State Highways presented at the annual convention of the National Highway Traffic Association, Detroit, Mich., April 29, 1921.

Presented by Chairman Herschel C. Smith, consulting engineer, Oklahoma City, Okla.

Highway Researches and Their Results-II *

Need of Information on Behavior of Various Pavement Types on Different Subgrades and for Data as a Basis for Rational Pavement Design—Description of Series of Tests and Studies being Conducted by the U. S. Bureau of Public Roads

By A. T. GOLDBECK†

(Continued from June 29)

Investigation of Subgrade Materials

During the past year a very important investigation has been started, that of the determination of the causes for subgrade failures. It is, of course, a matter of common observation that road failures have occured in particular parts of the country due to the failure of the underlying subgrade coupled, of course, with the presence of extremely heavy traffic. The bearing value of the subgrade in its softened condition has been insufficient to support the heavy loads applied to the road surface. On the other hand, other roads in other parts of the country have carried heavy loads and have carried them successfully. It is true there have been differences in the design of road surface, but at the same time where these differences in design do not exist and the traffic is quite similar some road surfaces fail and others do not. We must look then for the causes of these failures to the underlying subgrades.

We know, of course, that certain soils are affected by water, that is, when they absorb water they become very much softened and have very little supporting value. All soils, however, are not affected in the same way, nor are all soils capable of taking up by absorption or capillarity the same amount of water. We are all familiar with the extremely wide range in characteristics of soils which are apparent to the eye. And we are also familiar with the fact that roads laid on these different soils have behaved in vastly different ways. The evidence then points to the possibility that soils are suitable, or are not suitable as subgrade material, depending upon their physical characteristics. Just what these characteristics should be to render a soil of satisfactory quality as a subgrade material at the present time are rather indefinitely known, and for this reason we have begun an investigation to look very carefully into the physical properties of soils with the idea of comparing these physical properties with the service behavior of the subgrade in actual service.

Our method of procedure thus far has been as follows: With the aid of our district offices we have had collected almost one hundred samples of soil taken from the subgrades of roads throughout the country. Some of these samples have been selected from spots in the road where a subgrade failure has taken place. Other samples have been taken from spots in the same road where there has been no failure. When the samples are taken, very complete observations are made with regard to a number of points which might have some bearing on the cause of the failure. Thus, careful notes are made with regard to the drainage system; the topography in the vicinity of the failure; borings are taken in some cases to a depth of 5 ft., in order to explore the underlying strata and thus detect the presence of seepage layers or layers of impervious quality. Such borings often throw light on the reason for the presence of excessive amounts of water. Data with regard to the construction features of the road and with regard to the traffic are likewise obtained and, in fact, all of the supporting information necessary to determine the cause of the failure or success is recorded.

The sample of subgrade material sent to the laboratory has a volume of about 1 cu. ft., and in the laboratory the sample is subjected to tests with the idea of determining the following characteristics:

1. Percentage of clay and percentage of silt.
2. Colloidal properties.
3. Mechanical analysis.
4. Slaking value.
5. Cementing value.
6. Bearing value.
7. Specific gravity.
8. Capillary properties.
9. Moisture equivalent.
10. Miscellaneous properties, such as volume changes with moisture, volume changes with freezing, compressive strength, etc.

In the present paper it will obviously be impossible to go into detail in the description of all the methods pursued in these physical investigations, nor will such detail be necessary. These methods are described in mimeographed form, and will shortly be issued as a publication by the Bureau of Public Roads. It will be well, however, to point out the results obtained on a few samples examined, for these results have already shown us why roads have failed on certain types of soils and have stood up well on other types.

The results which are thus far most significant

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*Paper presented at the 1921 Convention of the American Road Builders' Association, Chicago, Ill.

†Engineer of Tests, U. S. Bureau of Public Roads.

are the results of the bearing value test. In order to understand them, it will be necessary to describe briefly the methods at present being followed in making this test.

In the natural subgrade of a road, soils are subjected to extremely varying conditions. At times they are saturated and other times they are perfectly dry. At times they are expanded through ice action, and are then thoroughly saturated with moisture while in that condition. Again they may be thoroughly compacted and in either a dry or wet condition. To gain the most useful information it has been thought necessary to attempt to simulate field conditions in the laboratory, and this attempt is the basis of our present procedure.

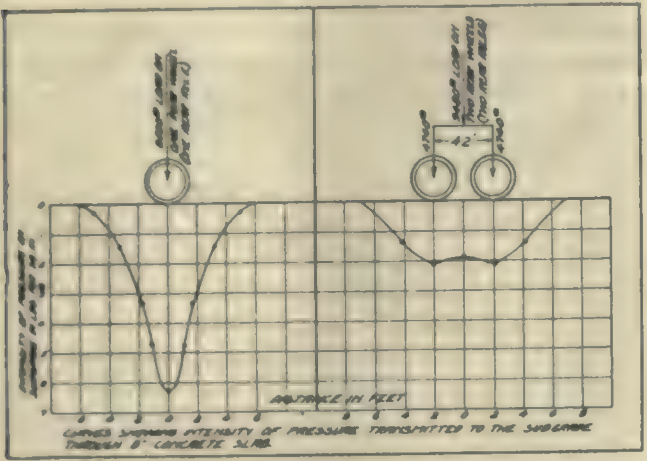

FIG. 9

Preparation of the Sample

The soil is broken up in a mortar by means of a rubber covered pestle, care being taken not to break any of the rock fragments. It is then passed through a ¼-in. screen. That portion passing a ¼-in. screen is then run through several rubber rolls to pulverize the soil without grinding it. The pulverized soil and the coarser materials are then combined and thoroughly mixed.

Bearing Value Test

The first consideration in making the bearing value test is to determine the range through which the moisture content should be varied. The lowest percentage of moisture is determined by the workability of the soil, that is, just enough water is added to the sample to enable it to be thoroughly mixed and placed in the small mold homogeneously. The maximum percentage should be that which corresponds to the saturation point of the soil. This is determined by the per cent. of water which the soil will take up by capillarity when loosely compacted. Two intermediate percentages of moisture are taken such that the interval between the four percentages is about the same.

The second consideration is the application of initial pressure. The initial pressure determines the compaction of the soil and tentative initial pressures are being used as follows: 10, 30, 50, and 100 lb. per square inch. The complete bearing value test on a sample of soil consists, therefore, of tests with the soil having different percentages of moisture, and different applied initial pressures.

Having pulverized the sample as described above, it is mixed with the smallest quantity of water to be used in the series of bearing value tests. The sample is kneaded with the hands, protected by means of rubber gloves, and is then placed in a cast-iron cylinder 6 in. in diameter and 6 in. high. The plunger is then placed in the cylinder and the soil is compressed in the testing machine under a definite pressure for a period of five minutes. Initial compressions are used as stated above. Having subjected the sample to initial compression the plunger is removed and a circular bearing block is placed on top of the specimen; a pressure is again applied at the lowest speed of the testing machine and simultaneous readings are taken of the pressure applied and of the penetrations of the plunger. The penetrations are obtained by means of Ames dials, reading to one-thousandths of an inch. Having completed a bearing value test with the smallest initial compression of the sample, the soil is removed from the plunger and is replaced and subjected to another initial compression, and the bearing value test is repeated.

When the sample has been tested when prepared with the four initial compressions outlined above, more water is added and it is thoroughly mixed, and bearing value tests are again run with the soil in this wetter condition. Finally, the test is run with the soil having the highest percentage of water mixed with it that a loose sample will take up by capillarity. By performing the test in this way it will be seen that the bearing value is obtained with the soil prepared artificially, much in the same way that it is prepared by nature, in that it is subjected to a range

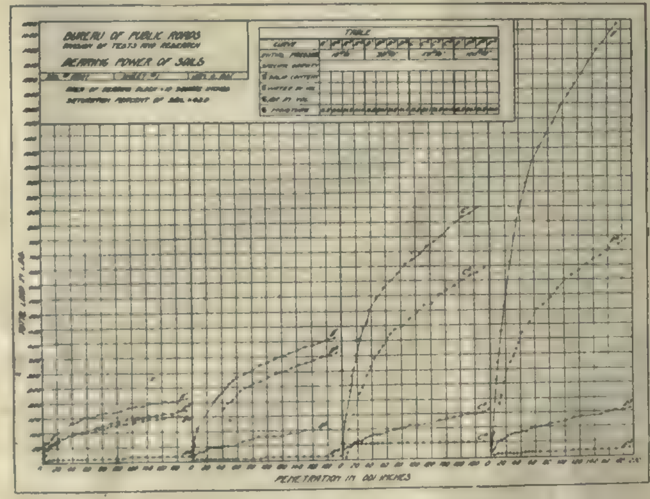

FIG. 10

(Concluded on page 10)

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

Founded January, 1892

E. L. POWERS
Editor

T. A. HULBERT
Managing Editor

11 WAVERLY PLACE
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Cable Address: Gudrodes, New York

Copy for advertisements must reach the New York office by noon on Tuesday of the week before date of issue if proofs are to be submitted.

Copy for classified and other advertisements where proofs are not required will be accepted until noon on Monday of the week of issue.

Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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Vol. LXI July 6, 1921 No. 1

THE PERSONAL EQUATION IN HIGHWAY WORK

Correct design, uniformly good materials, proper construction methods, competent supervision and honest and intelligent inspection are all prerequisites of a good pavement.

The lack of any one of them is likely to result in failure.

And failure is possible even though all of them appear to have been employed, because the personal equation is ever-present.

Attention is called to this phase of highway work elsewhere in this issue in an abstract of a paper by James C. Travilla on brick pavements. This, and many of his other comments on brick pavement design, are equally applicable to work with other types.

BUILDING ROADS TO THE NATION'S PLAYGROUNDS

Probably the automobile has done more than any other one agency to get people out of doors and supply them with the means to "See America First."

Whatever of evil is charged up against the motor car, such as causing extravagance, making city streets dangerous and the like—in all of which there is just about enough truth to make the wails of the calamity howlers plausible—its urge towards the great outdoors will have to be entered on the credit side.

Such work as that described in the first article in this issue—the building of a road opening up a playground heretofore inaccessible except by traveling a difficult trail—adds to the potential value of the automobile as a means to health and pleasure.

We are apt to look at road building from a purely utilitarian viewpoint. Primarily, of course, the highways are parts of the country's commercial transportation system. But their use for clean, healthful recreation should not be ignored; it is important.

DISTRIBUTING HIGHWAY COSTS

"The proper analysis and just distribution of the cost of construction and maintenance of state highways is one of the most important economical (economic) principles in the science of highway improvement," in the opinion of the National Committee on Equitable Distribution of the Cost of Construction and Maintenance of State Highways. The committee's report to the parent body, the National Highway Traffic Association, is printed in full on other pages of this issue.

This statement squares with the best thought of students of highway improvement, and is a matter to which attention has been called very often in this column. It can not be emphasized too much—by reiteration or otherwise.

The present method of apportioning the burden of highway improvements is not equitable. It needs revision, but before revision can be effected intelligently there must be a great deal more study of the complex interrelated problems that are involved. At present there are not sufficient data to make thorough and correct revision possible.

ROAD RESEARCHES BY THE BUREAU OF PUBLIC ROADS

Researches of very great importance to the science and art of road building are being conducted by the engineers and chemists of the Bureau of Public Roads of the U. S. Department of Agriculture. One of the many lines of study undertaken by that bureau is described in a paper by Testing Engineer Goldbeck of the bureau, the second installment of which is printed on other pages of this issue.

It has been pointed out many times that road building is not yet an exact science. There are many unknown quantities in the road builder's problem, and, though more and more rapid advances are being made, there is now a greater need than ever before for exhaustive studies and experiments with both materials and methods of construction.

Among the most important of the needed researches are those having to do with the effects of traffic upon road surfaces, upon foundations, and upon subgrades. These naturally call for heavy and somewhat costly apparatus, scientific methods of control and long observation periods or else tests that are greatly accelerated. Few of the state highway departments have the men or the means to undertake the required experimentation, though some of them have done valuable work in spite of those handicaps.

Under the circumstances, the Bureau of Public Roads is the logical agency for carrying on the work and it should have the fullest measure of cooperation from everyone in the road building field. There are doubtless many ways in which road builders can assist the technicians of the bureau—in addition to those they have found already—and we believe that the officials of the bureau have only to make their wishes known to obtain any desired assistance that it is within the power of the country's road builders to give.

Road Conditions on the Lincoln Highway Better than Ever

(Concluded from page 2)

Nebraska, as "the roads dry with great rapidity and unless the storm is of exceptional severity the journey may be resumed without difficulty in but a few hours after the sun has come out." In Nebraska, however, it is explained, "Splendid progress has been made in grading, draining and graveling and the wet weather 'taboo' has been practically eliminated."

Only three years ago the route across Wyoming was merely a trail, but it has been greatly improved and there is now less than 60 mi. of hard driving in the 400 mi. across the state.

In crossing Utah it may be necessary to follow the old route of the highway around the south end of the Great Salt Lake Desert, through Fish Springs and Callao, because of the failure to complete the "Goodyear Cut-Off." Considerable improvement has been made in the Nevada section where, it is stated, the motorist is never more than 45 or 50 mi. from supplies of all kinds and the longest stretch between places where water and gasoline can be obtained is 37 mi.

In California pavements are found again, road conditions being excellent, for the most part.

Brick Pavement Design

(Concluded from page 3)

Rolled bases must be thoroughly seasoned and compacted to obtain good results with the surfacing. The thickness needed for such bases depends upon the bearing power of the subsoil, drainage, and climatic conditions. Usually, 6 or 8 in. of compacted material will be sufficient. The curb or edging may be of cement concrete or bituminous macadam.

A 12-in. bituminous macadam edging on each side of a brick pavement on a rolled base serves to waterproof the berm and widen the roadway. It also affords vehicles an easy approach from the shoulder to the paved part of the road, as compared with a rigid curb or edging. The cost of maintaining an edging of this type is an item to be considered, but its merit in connection with a pavement of this type would appear to justify a small maintenance charge.

A brick pavement properly designed to meet local conditions will not provide a satisfactory wearing surface unless proper attention is given to the details of construction.

The personal equation is a factor that affects the results obtained from the materials built into a pavement of any type. As brick is a ready-made material, the individual units may be inspected before use, so securing uniformity in the surfacing. The word "uniformity" is a good slogan to adopt for materials and methods of construction, for uniformity directly influences the life of a surfacing material and the stability of a pavement as a unit.

Paving bricks are usually 8½ in. long, 3½ in. wide, and 3, 3½ or 4 in. deep. The specifications of the American Society for Municipal Improvements provide that "only brick with four raised lugs on one side, not to exceed one-fourth (¼) in. nor less than one-eighth (⅛) in. in height, shall be used." The purpose of this is to secure a brick that will provide, automatically, a definite and positive joint for the filler to penetrate. The ends of the brick are double beveled to provide end joints. The edges of a re-pressed brick are rounded, while the edges of a wire-cut brick are square.

Wire-cut lug brick came into use in 1910 as the remedy for the following characteristics of the repressed brick: Non-uniformity in size; rounded edges that failed to hold the filler flush with the brick surface; and inherent weakness due to the laminations formed during the re-pressing process.

The Distribution of Highway Costs

(Continued from page 4)

improvement of highways which accrues to the general public. The operator of a motor truck derives a benefit from the improvement of highways only in so far as it enables him to transport more advantageously than by other means. The benefit of the improvement coming through motor truck use eventually accrues to the producer and the consumer of the products hauled.

Distinction Between Construction and Maintenance Costs

The benefits of the construction of a highway accrue to the public served by the highway. It is never limited to those who use the highways. The store-keeper, farmer, and man retired from business receive these benefits even though they may never have a vehicle on the road. Nor does the benefit necessarily accrue to those using the road in proportion as they use it. The truth of this statement is evident by comparing the benefits derived by an owner of large tracts of land along the road, who may use the road relatively little, with the benefits derived by a truck gardener who owns little land, but who may use the road every day. While the benefits derived by individuals do not depend upon the extent of their use of the road, the benefits are only possible by virtue of the road being used. The cost of construction, then, should be distributed according to the benefits derived.

The equity of collecting the cost of maintenance directly from the same source is not so obvious. The cost of maintenance depends directly upon the amount and character of traffic to which the road is subjected. Capital, properly invested in highways, should be maintained out of the return from the highways. The amount of maintenance, depending directly upon the use to which the road is put, should be assessed as nearly as possible directly upon the use of the road.

Assuming that proper regulatory measures are enforced pertaining to the transportation of particularly heavy and destructive machinery over the highways, the maintenance of highways will depend, not entirely but largely, upon the automotive vehicle traffic. The error in assuming that all maintenance on state trunk highways is due to the motor traffic is not great, due to the predominance of that type of traffic, and that error is fast becoming more nearly negligible as motor traffic supplants horse-drawn.

Conclusion

In this, its final report, the Committee submits, for consideration by the members of the Association, the following principles relative to the equitable distribution of the cost of construction and maintenance of state highways:

1. That the construction of state highways should be financed by general taxation.
2. That maintenance of state highways should be financed through the medium of license fees for the use of motor vehicles, provided the highways built are of types most economically suited to the traffic to be carried.
3. That the cost of maintenance of state highways should be so distributed as to encourage the fullest development of commercial use of the highways, as therein lies their greatest economic value.

Georgia Road Work

At an expenditure of $3,000,000, the State of Georgia has completed 62 road projects in 36 counties, according to a recent announcement. In addition, 161 projects in 11 counties are under way which involve an expenditure of $14,000,000. Plans are also being prepared for 78 projects in 53 counties, which will cost about $2,000,000.

New Jersey Road Grafters Fined

Three Cape May County Freeholders Plead Guilty and 14 Indictments are Still Pending

Three present and former county freeholders of Cape May County, New Jersey, of the 17 recently indicted in connection with road graft, pleaded guilty on June 14 and were fined by Supreme Court Justic Charles C. Black.

James F. Eustace, Vice Chairman of the Board of Freeholders, was fined $500; Henry S. Rutherford, a former director of the board, was fined $500, and Charles Yorke, a former member of the board was fined $100. William M. Cassidy, of the firm of Homan & Cassidy, Cape May, contractors, changed his plea of not guilty to nolle contendre. Trial of the other defendants, who have pleaded not guilty, will be commenced on Sept. 19. It is reported that the convicted men will be witnesses for the state at the trial of the remaining defendants.

The defendants are charged with collusion between the Board of Freeholders and contractors in the construction of roads and the provisions of supplementary work, which violated statutes of the state and county.

Road Work in New York

Immense Problem Faces State in the Maintenance of Highway System

The State of New York plans to construct 500 mi. of hard-surfaced roads during the present year, according to Herbert S. Sisson, State Commissioner of Highways. Contracts have already been let for 387 mi. at a total cost of $14,883,800. The completed mileage to date is placed at 138 mi., of which 73 mi. are concrete, 35 mi. bituminous macadam and 30 mi. of other types of pavement.

The highway program of New York as outlined in the Hewitt Law passed at the last session of the Legislature, calls for the completion of about 3,000 mi. of highway in the next six years. "Unless something unforeseen occurs," says Commissioner Sisson, "there is no reason why this program can not be completed within the time contemplated by the drafters of this act.

"At present we have approximately 2,000 mi. of improved highways, built from 10 to 20 years ago, of water-bound macadam of a thickness of 6 to 9 in. Motor traffic is extremely destructive to roads of this type and they must be rebuilt of material that will carry this kind of traffic. The repair and maintenance of our highways is one of the great problems this department is facing. It will be necessary to rebuild these 2,000 mi. and to keep in repair the roads of the better type.

"This state will expend this year approximately $9,000,000 for maintenance and rebuilding of its 8,000-mi. system now completed."

Highway Researches and Their Results

(Continued from page 6)

of moisture content and a range of compaction. In the above manner the curves shown in Figs. 10 and 11 have been obtained. Only a few typical curves are shown.

It is not my wish to enter into a detailed discussion of the results at the present time. I should like, however, to point out certain indications in the results obtained with two soils having considerably different characteristics. It has been stated that observation tells us to expect trouble from road failures in the spring of the year when the subgrade is thoroughly saturated with water. In judging of the bearing value of a soil we should, therefore, judge it by its saturated condition. Soil No. 16807, shown in Fig. 10, is adobe soil and comes from a road that failed very badly. Note that this soil absorbed 42% by weight of water when saturated. Note also that when this soil was saturated, no matter whether it received an initial compression of 10 lb. per square inch as in curve A, or 100 lb. per square inch as in curve D, its bearing value was exceedingly low. In fact, judging from the curve it would seem that in a saturated condition this soil would support a load of barely 2 lb. per square inch, and under this load there would be continued sinking. A special sand-clay mixture, on the other hand, composed of 75% coarse sand and 25 % clay, as shown in Fig. 11, absorbed only 16% of water by weight of dry sample when it was saturated, and it will be observed that the curves of bearing value show considerably higher ability to support loads than in the case of the adobe soil. It will also be noted from these curves that soils of this character having a higher percentage of coarsely granular material, when densely compacted have higher bearing value than when loosely compacted even when the soil is saturated. This is unlike the exceedingly finely divided adobe soil. It will also be noted that the sand-clay has considerably higher bearing value than adobe when both are saturated.

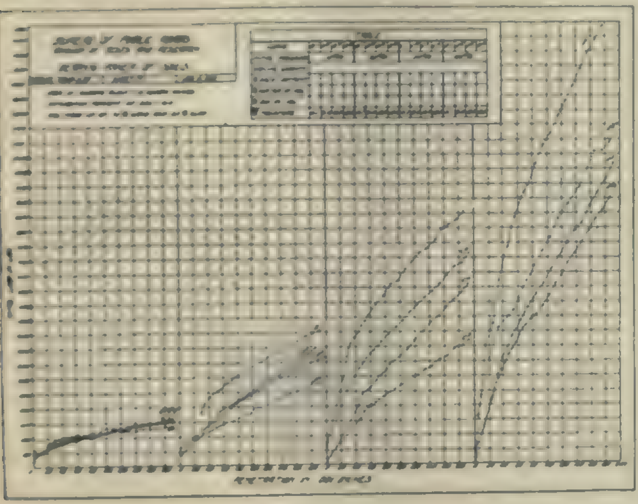

FIG. 11

Attention was called to the pressure obtained by actual measurement under an 8,500-lb. wheel load on the Camp Humphrey's 8-in. concrete road, the pressure there being 6.5 lb. per square inch due to this load. The bearing value test on the adobe soil shows it to have a maximum resistance when saturated, of only 2 lb. per square inch. Is it necessary to proceed any further to show why certain roads laid on certain types of soils have failed utterly? Would we think of designing the footing for a building in such a way as to produce greater pressure on the soil than the supporting value of the soil under that footing? Yet, that very thing is being done in the case of roads laid on certain types of soils, and naturally the soils yield with the distortion of the road surface. Before leaving the curves just described, it is interesting to note the exceedingly high bearing values to be expected even from adobe when it has a low percentage of moisture and when it is tightly compacted. Such values are shown by Curve D1. This, of course, bears out our common experience that even the worst kind of clay soil will support heavy loads so long as it is dry and compact.

I do not wish to give the impression that we have proceeded far enough with our investigation to say what physical characteristics soils must possess to render them of high bearing value. I do feel, however, that we are gradually obtaining results which in the end will give us this information. It would seem, however, that our results are pointing to the conclusion that fine graded and exceedingly plastic soils, when saturated, are apt to give considerable trouble and that the coarse grained, more porous soils which drain well and have high bearing value will give the least trouble. There is gradation, however, between these types and it is our aim to couple the bearing value of these gradations with the physical characteristics and likewise with the possibility of these different soils to be drained by various systems of drainage.

(To be concluded)

California Tries Oiling Subgrade of Alkaline Soil

Experiments are being carried on by the California State Highway Commission on a road in Kern and Los Angeles Counties to determine what value oiling the subgrade will have in overcoming the difficulties encountered in laying concrete pavements on alkaline and adobe soils. The subgrade in the experiment is being treated with oil by penetration, with the idea that such insulation may protect the concrete. Another section of road is being placed with a 4-in. course of gravel between the concrete and subgrade.

Cement Makers Sued by Government

Civil Suit Begun Under Sherman Act for Dissolution of Cement Manufacturers Protective Association

Charging that the Cement Manufacturers Protective Association constitutes a conspiracy in restraint of trade by means of which certain cement makers have exacted "unconscionable prices" for their product and have unduly curtailed building operations, the Government, through United States Attorney William Hayward, has begun a suit in the United States District Court in New York City for the dissolution of the association.

The association against which steps have been taken has headquarters in New York City and has a membership of 29 cement manufacturing companies in New York, New Jersey, Pennsylvania, Maryland, Virginia and West Virginia. All but one of the firms involved are under criminal indictment, brought last March, on a charge of violating the criminal provisions of the Sherman Act.

Georgia Maintenance Organization

Patrolmen Have Charge of 50-Mile Sections Under Direction of a Maintenance Supervisor In Each Division

The Maintenance Department was formed just prior to May 1, 1920, and there was immediately put into motion an organization to maintain the roads that have been accepted, as completed, by the state highway engineer.

The sections of improved roads that were transferred to maintenance were, until March 15, 1921, handled directly from the general office at Atlanta by the chief field engineer, assisted by the maintenance engineer, and the methods used for 6 to 50-mi. sections were as follows:

There was employed a patrolman, with assistants, for the longer sections, whose duties required that he go over his section after each rain with a drag, as it is most essential that ruts formed by the traffic be filled while the material is damp to enable same to pack and to keep the surface even. He also kept all ditches cleaned and open. The patrolman reported his daily progress to the Atlanta office, showing the time and the cost of material used, and condition of his section throughout. In that way the office had in its files the condition of a maintenance project within 24 hours after a rain.

By March 15, 1921, the work of the maintenance department having greatly increased through the acceptance of numerous completed projects, this department was reorganized.

Each division engineer now has the direction of the maintenance in his district and has employed a maintenance supervisor who closely supervises the maintenance activities in the district, having direct control of his organization of patrolmen and laborers.

The supervisor reports daily to his division engineer and weekly to the maintenance engineer in Atlanta, through the division engineer.

The state roads, as constructed, are divided into 50-mi. sections—more or less—and road section foremen employed, who are being equipped with the necessary maintenance tools—tractors, trucks, road machines, and the necessary hand tools, etc.—to keep their sections up to the standard.

A section gang usually consists of a foreman and three laborers.

Immediately after a project has been completed by the contractor, and the final estimate, as submitted by the division engineer has been approved by the highway engineer, the road completed is transferred to the Maintenance Department to maintain.

A foreman is then assigned to maintain this improved section by sodding slopes, clearing right of way, and repairing the surface as it shows signs of wear.

A manual of instructions to employees was issued March 1, 1921, to simplify the making of reports, and also setting out exactly what would be expected of each employee.—*Third Annual Report of the State Highway Department of Georgia.*

Pennsylvania Markets Bonds

$9,000,000 of 5 per cent State Highway Bonds Sold at Par and Accrued Interest

Bids were received on June 21 by the Pennsylvania State Highway Department for the purchase of $15,000,000 of state highway bonds, ranging from 101.30 to par, on a total of nearly $9,000,000 of the bonds.

The principal bid was made by a syndicate composed of Drexel & Co., Brown Bros. & Co., both of Philadelphia, Guarantee Co., Harris-Forbes Co., National City Co., of New York, and the Union Trust Co. of Pittsburgh. This syndicate bid on $8,000,000 of the bonds at par and accrued interest, with the proviso that all other bids be rejected and that the remainder of the bonds should not be offered until October, 1922. This stipulation was later withdrawn.

Other bidders on the bonds, which bear 5% interest, were Harrison Smith & Co., Philadelphia, $40,000 at par; Harry F. Porter, Philadelphia, $40,000 at par; George H. Stewart, Shippensburg, $40,000 in lots of $10,000, at 100.75, 101, 101.10 and 101.30; Charles Ferrand & Co., Philadelphia, $100,000 at 100.073; Townsend-Wheelen & Co., Philadelphia, $25,000 at par; Board of City Trusts, Philadelphia, $500,000 at par.

Governor Sproul has announced that all bidders will receive the amounts bid for and that the offer of the syndicate to buy the remainder of the issue if it could find a market had been accepted.

Salaries Of Pennsylvania Highway Officials Increased

Assistant State Highway Commissioner Gets More Money than Governor

During the last session of the Pennsylvania Legislature a law was passed permitting the State Highway Commissioner to fix salaries of highway officials, with the exception of his own. In accordance with this law, Commissioner Sadler recently increased the salary of George H. Biles, Assistant Commissioner, from $8,000 to $12,000; Col. William D. Uhler, Chief Engineer, from 7,500 to $10,000, and Joseph W. Hunter, Township Commissioner, from $6,000 to $6,600.

Convicts on New York Roads

250 Prisoners in 9 Camps Engaged in Building Highways

About 250 convicts are now working on state and county roads in New York and their number will be increased to about 350 shortly.

Nine camps have been established, with from 10 to 30 convicts in a camp. Convicts from Great Meadows Prison are in three camps and are building the Bolton Landing Road at Lake George, the Comstock-Greenville Road and the Warrensburg-Chester Road. Two camps of prisoners from Dannemora Prison are constructing the Dannemora-Cadyville and Holleywood-Sever Roads. Three camps of Auburn Prison convicts are building the Scipio, Montezuma, Swamp and Marathon Narrows Roads in Cayuga and Senecca Counties, and one camp of Sing Sing prisoners is doing maintenance work in Dutchess County.

The convicts, it is reported, are eager to be assigned to road work, and for the most part make excellent workers.

Nebraska Convicts Build Roads

Prisoners and Civillians Used Together on State Highway Work—200,000 Yards of Material May be Handled

The first prison camp established this year in Nebraska, according to the "Monthly Report" of the Department of Public Work of that state, was set up near Crab Orchard for the construction of Project No. 43, Tecumseh-Crab Orchard. The force consisted of 21 prisoners and 15 civilian laborers, and work was started on April 21. When the "Monthly Report" for May was issued, 5.5 mi. of last season's work had been completed. There remained 2.5 mi. of heavy construction to complete the project. The convicts are used to handle the teams and the skilled work is done by the civilian laborers.

The second and third camps were established on May 31, the former at Seward and the latter at a site about 4 mi. west of Pawnee.

The 15 prisoners and 10 civilian laborers at the Seward camp are working on the completion of about a mile of construction held over from last year. The other camp, in which there are 21 colored convicts and 14 civilian laborers, is to complete 6 mi. of unfinished construction.

"If the end of this season's work is as successful as the beginning," according to the report, "nearly 200,000 cu. yd. of excavation will be moved by this particular type of labor."

Roadside Gasoline Stations Menace to Traffic, Says Wasser

State Highway Engineer Thomas J. Wasser of New Jersey recently conferred with representatives of large gasoline selling companies relative to the elimination of gasoline filling stations from roadsides and at important intersections of the state highway system.

"Serious accidents have already occurred and traffic has been unnecessarily congested at several points along the highways due to the fact that garage owners and filling stations have tanks located along the highway within the graded right of way and also along the curbs in municipalities," said Mr. Wasser. "It is the intention of the commission to arrive at some solution of the problem as to the probable location of tanks in the future and also what is to be done with tanks already placed."

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Craig County, Oklahoma, plans to build 12 bridges during this year.

Grand Ledge, Mich., recently voted a bond issue of $11,000 to pave North Bridge Street.

The North Carolina State Highway Commission will open bids on July 15 for $5,000,000 of state road bonds.

New Madrid County, Missouri, recently sold $250,000 of road bonds to the First National Bank of St. Louis at 95.

A Wooden Bridge in Pittsburgh, Pa. connecting Beechwood Boulevard and Schenley Park, collapsed on June 18. No one was injured.

Six Employees of the Pennsylvania State Highway Department have pleaded guilty to padding pay rolls. The total amount involved is $9,285.

The Missouri Legislature convened on June 14 to enact legislation providing a definite plan for building a state system of highways, as provided in the referendum vote of last year authorizing the issuance of $60,000,000 of road bonds.

MEETINGS

Calendar of Coming Meetings

Aug. 30-Sept. 1—Michigan State Good Roads Association.—Annual meeting, Flint, Mich. P. T. Colgrove, Pres., Hastings, Mich.

Oct. 24-28—American Society for Municipal Improvements—Annual Convention, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

American Society for Testing Materials

The American Society for Testing Materials held its annual meeting at Asbury Park, N. J., on June 20 to 24, with an attendance of over 700. Several papers of interest to road builders were presented, considerable attention being paid to the discussion of concrete.

Among the papers presented were, "Tests of Soils with Relation to Their use in the Subgrade of Highways," by A. T. Goldbeck and F. H. Jackson, of the Bureau of Public Roads, and "Measurement of Impact of Motor Trucks on Roads," by E. B. Smith, of the Bureau of Public Roads. These papers outline some of the highway research work now being carried on by the bureau.

Prof. A. N. Talbot, of the University of Illinois, presented a paper on, "A Proposed Method of Estimating the Density and strength of Concrete and of Proportioning the Materials by the Experimental and Analytical Consideration of the Voids in Mortar and Concrete."

W. L. Schwalbe, of the University of Illinois, and Watson Davis, of the U. S. Bureau of Standards, presented papers on methods of testing the consistency of concrete, it being brought out that the flow-table test is better than the slump test. Duff A. Abrams, of Lewis Institute, gave a paper on the results of 10,000 tests on wear of concrete, showing that wear is apparently in inverse ratio to the strength of the concrete. L. G. Carmick, of the Bureau of Public Roads, in a paper on the use of slag for concrete aggregates, stated that there is a difference in composition in slags which do and do not disintegrate.

A resolution was passed by the society declining to become affiliated with the Federated American Engineering Societies. It was the feeling that the required contribution to the Federated American Engineering Societies would curtail the work of the society unless dues were raised.

Charles D. Young was elected president; G. Aertsen, vice president, and F. R. Baxter, E. D. Boyer, F. M. Farmer and W. H. Fulweiler were elected members of the executive committee.

Engineering Society of Akron, Ohio

The Engineering Society of Akron, O., at its recent annual meeting elected the following officers: President, J. H. Vance; Vice President, L. G. Tighe; Secretary-Treasurer, H. G. McGee; Directors; R. R. Methany and H. G. McGee.

Engineers' Society of Pennsylvania

The Engineers' Society of Pennsylvania held its annual meeting at Harrisburg on June 13 and elected the following officers: President, Richard V. McKay; First Vice President, Theodore E. Seelye; Second Vice President, Crosby Tappan; Secretary, Howard E. Moses; Treasurer, Harry T. Neale.

County Judges and Commissioners Association of Texas

The County Judges and Commissioners Association of Texas held its annual meeting at Fort Worth on June 22 and 23. Among the topics pertaining to roads that were discussed were: "The Maintenance and Construction of Roads with County Convicts," by John W. Roberts, Forth Worth; "State and Federal Roads," by T. H. Webb, State Testing Engineer, and Capt. J. D. Fauntleroy, District Engineer, U. S. Bureau of Public Roads; "The Road and Bridge Fund in General—its Requirements and Limitations," by J. R. Williams, County Judge, San Marcos and Dayton B. Steed, County Judge, Sherman; "Should Felony Convicts of Two-Year Terms and Less be Worked on County Roads?" by G. P. Lester, County Judge, Waco, and Nat Patton, County Judge, Crockett; "Commissioners Courts Contracting Road Work," by Olin P. McWhirten, County Judge, Greenville, and F. D. Love, County Judge, Georgetown; "The Construction and Maintenance of Designated Highways," by R. V. Glenn, Consulting Engineer, Tarrant County, and J. C. Nagle, Dean, Texas A. & M. College, and others; "The Best Method of Maintaining Lateral Roads," by Thos. McWhirter, County Commissioner, Ellis County; "The Best Method of Maintaining Dirt Roads," by J. N. Henry, County Commissioner, Red River County, and W. J. Robbins, County Commissioner, Collins County.

Among those who gave addresses were, R. M. Hubbard, Chairman, Texas State Highway Commission; Earl B. Mayfield, of the Texas Railroad Commission, and P. M. Neff, Governor of Texas.

PERSONAL MENTION

A. B. Hagis has been appointed city engineer of Jellico, Tenn.

W. H. Harrington has been appointed city engineer of Tracy, Cal.

F. H. Dryden has been appointed city engineer of Salisbury, Md.

J. E. Caton has been appointed city engineer of Eldorado, Kan.

Fred. S. Morse has been appointed city engineer of Springfield, Ill.

G. S. White has been appointed city engineer of Fort Morgan, Colo.

Albert Givan has been appointed city engineer of Sacramento, Cal.

R. J. Rice has resigned as county surveyor of St. Louis County, Minnesota.

H. T. Hare has been appointed county surveyor of St. Louis County, Minnesota.

M. J. Stinchfield has been appointed assistant state engineer of Indiana.

William Sachs has been appointed borough engineer of West Hazleton, Pa.

W. O. McCluskey has resigned as county engineer of Ohio County, West Virginia.

Alexander C. Hoffman has been appointed county engineer of Ohio County, West Virginia.

D. J. Schneider has been appointed city engineer and commissioner of streets of Pocatello, Idaho.

Judson Wamsley has resigned as county superintendent of roads of Montgomery County, Pennsylvania.

William Redington has been appointed county superintendent of highways of Montgomery County, Pennsylvania.

James V. Karrick has been appointed bridge designer by the Kentucky Department of State Roads and Highways.

Thomas C. McEwen has been appointed district engineer with headquarters at Jackson by the Tennessee State Highway Department.

Col. Washington A. Roebling has been elected president of the John A. Roebling's Sons Co., builders of the Brooklyn Bridge. Col. Roebling is 84 years old.

E. R. Rodenburg, for the past ten years assistant city engineer of East St. Louis, Ill., has been appointed chief engineer of the East Side Levee and Sanitary District, East St. Louis.

David Rose has resigned as county engineer of Koochiching County, Minnesota, to become district engineer for the Minnesota State Highway Commission, with headquarters at Bemidji.

Charles A. Ellis, Professor of Bridge and Structural Engineering at the University of Illinois, has resigned to become president of the Strauss Bascule Bridge Co., of Chicago, Ill. Prof. Ellis graduated from Wesleyan University in 1900 and for the next two years was city engineer of Middletown, Conn. From 1902 to 1908 he was employed by the American Bridge Co. The next four years he was assistant professor of civil engineering at the University of Michigan. From 1912 to 1914 he was designing engineer for the Dominion Bridge Co. In 1914 he became assistant professor of civil engineering at the University of Illinois and was placed in charge of all courses in bridge and structural engineering in 1915.

PUBLICATIONS

STATE HIGHWAY DEPARTMENT OF GEORGIA. Third Annual Report. Paper, 6x9 in. Illustrated.

This report covers the year 1920-1921, giving in detail the various activities of the department during that period. In addition to the tables dealing with the finances of the department, a large number of photographs of various projects are shown, which present with great lucidity the progress of road and bridge development in the state.

BOARD OF PARK COMMISSIONERS, INDIANAPOLIS, IND. Twenty-fifth Annual Report, 1920. Paper, 6x9 in., 60 pages. Illustrated.

During the year covered by this report a tract of land of approximately 50 acres was acquired, situated along the east bank of the White River. Provision has also been made for the acquisition of 40 acres of ground between Martindale and Ralston Avenues. Among the recommendations contained in the report are the replacement of several retaining walls on drives and the replacement of three bridges.

GOOD ROADS

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THE HIGHWAY CONTRACTOR AND ROAD BUILDER

Vol. LXI. NEW YORK, N. Y., JULY 13, 1921 Number 2

Roadway and Sidewalk Widths [*]

Adequate Roadway and Sidewalk Widths a Vital Problem in Modern City—Should be Determined by Use to be Made of Street—Discussion of Theory and Derivation of Formulae—Bearing on City Planning

NARROW STREETS HANDICAP TRAFFIC in most cities and much money is wasted in building country roads of excessive widths. On the other hand, greater width than is needed is occasionally provided in the design of city streets and some improved main roads in the open country are so narrow that widening to accommodate a constantly and rapidly growing traffic will be required in the not far distant future. The problem of width is one that is susceptible, within limits, of exact determination. Some of the solutions for city streets and sidewalks are given in the subjoined paper.

The securing of adequate roadway and sidewalk widths is one of the most important problems in the modern city. Transportation is the foundation of our industrial and social life. The economic production and distribution of labor and materials, as well as community pleasures, are entirely dependent on transportation facilities. The fundamental purpose of the city street is to provide access to the abutting property and access to property or communities beyond. Public thoroughfares comprise about one-third the area of the subdivided property. Accessibility and location give city property its value. The character of streets, as well as roads, varies from the strictly local traffic street to the direct, heavily traveled through highway, or congested business street.

It is quite obvious that the width of the street is to be determined by the use to be made of it. The proper width of street is a summation of the width of roadway, width of sidewalks and extra or reserve width. The extra or reserve width is set apart for parkways, to add beauty and comfort, and to provide for future expansion of roadway and sidewalk width. In the typical city where the width of street is fixed and defined by buildings, the width of roadway and sidewalk must be carefully proportioned. Where these widths prove inadequate to accommodate the traffic the street must be widened by condemnation. Where this cannot be done, because of physical, legal or economic conditions, the traffic must be restricted and regulated by police power.

Width of Roadway

The width of pavement or roadway is determined by traffic needs, by tradition, by esthetic requirements or by limitations of site or cost. In the city, the value of the pavement to the users is of paramount importance. The pavement must prove safe and comfortable to use, must be truly economic, must present an agreeable appearance, and must accommodate the abutting property and the charcter and amount of traffic using it.

The realization of the above qualities is intimately affected by the factor of width of roadway. Owing to the great increase and diversified use of motor vehicles, the fundamental basis of pavement design today is to fulfill the needs of the traffic; to serve the users of the street in an efficient manner. The following quotation is from a paper presented before the 1920 annual meeting of the American Society of Municipal Improvements by Robert Hoffmann, Chief Engineer of the Department of Public Service, Cleveland, Ohio.

TWO POINTS OF VIEW

The determination of roadway widths may be considered from two different points of view. One is from the viewpoint of appearance, governed by rules of proportion, or by making

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[*] Report of the National Committee on Widths of Roadways and Sidewalks in Municipalities, presented at the annual convention of the National Highway Traffic Association, Detroit, Mich., April 29, 1921.

Presented by H. J. Fixmer, Paving Engineer of the Board of Local Improvements of Chicago, Ill., Chairman.

> provision for predetermined widths of sidewalk strips or for lawn and parking spaces. The other viewpoint is that of traffic accommodation.
>
> The first viewpoint applies principally to parkways, boulevards and certain classes of residence streets where beauty and proportion largely control the design rather than economy and utility. Making the roadway from 50 to 60% of the street width between property lines will, in many cases, satisfactorily suit conditions. The design of the planting strips and lawns will, however, nearly always control the width and arrangement of the paved roadways. Even here the expected traffic should receive consideration, but its subordination to other conditions may be perfectly logical and free from criticism.
>
> Consideration of roadway widths from the second viewpoint, that of traffic accommodation, obviously applies to the greater number of cases, and should be the prevailing point of view when considering any basis of design or the standardization of widths."

Kinds of Traffic

There are five general classes of traffic using the city street. These are: Pedestrian, horse-drawn, motor-driven, street railway and stationary traffic. Stationary traffic consists of vehicles loading or unloading merchandise, and vehicles, mostly motor-driven, appropriating the public space for parking. Since all classes of traffic have the common right to use the street, the street should be designed to afford each class the maximum of comfort and safety without abridging or destroying the rights of the other classes.

Effective Width

The effective width of roadway is that part available to moving traffic. The effective width of roadway is affected by the presence of street railway tracks, by the provision for parking vehicles, by the custom or necessity of backing vehicles against the curb to load and unload material, by slippery surface, by excessive crown of surface, by accumulation of snow and refuse, and by uneven or worn-out pavement surface.

Requirements of Traffic

The width of roadway required for traffic is a function of the necessary clearance, of the width and permissible speed of the vehicles, and of the volume or amount of traffic. The relation between roadway width and width of vehicle, for each line of traffic (standing or moving), is given by the following formula:

$$\text{(I)} \qquad W = B + C + \frac{S}{10}$$

in which S is the permissible maximum speed (in miles per hour) of the vehicle traffic; W is the required width of roadway for one line of traffic parallel with the street axis (in feet); B is the width of vehicle (over-all) in feet; and C is the lateral clearance factor, varying from 0.5 to 1.0.

Thus, in order to fix the width of roadway to accommodate the character of traffic, the widths, particularly the allowable maximum, of all vehicles, together with the permissible speed must be known. Where vehicles stop or park parallel with the street axis the required width from the formula is over-all width plus 0.5 ft. Where vehicles are permitted to park at an angle or back against the curb to handle goods, the width must be increased from 6 to 12 ft. over the width needed when standing parallel with the curb. The space to be provided for parking, or so-called stationary traffic, must be definitely settled.

To determine the effective width or width to be kept open for moving traffic, we must know the number of moving lines of traffic to provide for.

The distance required to stop a motor-driven vehicle, equipped with proper brakes, road in good condition and driver alert, is determined by the following formula:

$$\text{(II)} \qquad D = \frac{S^2}{10}$$

where D is the distance in feet to stop vehicle, and S is the speed in miles per hour (maximum).

The headway required for fast moving vehicles varies with the maximum speed, the factor of safety assumed (to allow for poor brakes, possible slipperiness, time for driver to act), and the length of the vehicle.

$$\text{(III)} \qquad H = DF + V$$

where H is the headway in feet (distance apart, center to center); F is the factor of safety (ordinarily equal to 2), and V is the length of the vehicle in feet. (V is important only at low speeds, and varies from 10 to 30 ft., depending on the kind of vehicle.)

The maximum number of vehicles per hour per line of moving traffic* is given in the following formula:

$$\text{(IV)} \qquad N = 5280 \frac{M}{H}$$

where N is the maximum number of vehicles per hour per line of moving traffic, and M is the assumed average speed in miles per hour.

The number of lines of traffic to be provided for should be based on the future use of the street. A traffic census is of little value unless carefully interpreted, and then is important only as an aid to judgment.

The total width of roadway to accommodate the character of traffic using a given street is the summation of the number of traffic lines required for moving and stationary traffic.

A given width reaches its greatest capacity when speed is uniform or average speed approaches the maximum speed. This ideal condition is never reached and is closely approached only on long stretches of open country road or certain boulevards.

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*See article by author in "Engineering & Contracting," April 2, 1919, page 328.

On the city street the speed is restricted to a low average, due to frequent cross traffic, presence of car tracks, and mixed character of traffic. To accommodate an increase of traffic the roadway must be widened or the maximum speed and even the average speed must be reduced. A double track street railway requires a width of 20 ft. for safe and rapid operation. On streets other than those carrying car tracks the requirements of rapid vehicle traffic indicate a minimum width of 20 ft. for the rapidly moving middle traffic.

ARRANGEMENT OF ROADWAYS, WALKS AND PARKINGS ON NORTHEAST BOULEVARD, PHILADELPHIA.

Regulation of Width and Speed of Vehicle

The necessary width of roadway for vehicle traffic is a function of clearance, width and permissible speed of vehicle as shown in Formula I. The following table shows necessary width for each line of traffic:

$$\left(W = B + 0.5 + \frac{S}{10} \right)$$

TABLE I.—RELATION OF ROADWAY WIDTH TO WIDTH AND SPEED OF VEHICLE

Permissible speed of vehicle in miles per hour	Overall width of vehicle (in feet) 6	6.5	7	7.5	8	8.5
	Width of Roadway Per Line of Traffic					
Parked or standing (parallel to curb) (stationary)	6½	7	7½	8	8½	9
5	7	7½	8	8½	9	9½
10	7½	8	8½	9	9½	10
15	8	8½	9	9½	10	
20	8½	9	9½	10		
25	9	9½	10			
30	9½	10				
(40?)	10					

Apart from consideration of pavement damage due to impact, tire equipment, etc., the speed must be regulated from the standpoint of public use, safety and economy. It appears that 10 ft. should be the proper width for each line of rapid traffic, and 8 to 9 ft. for side, or slower moving traffic. Thus a truck measuring 8.5 ft. over all would be limited to a maximum speed of 10 mi. per hour, and should not travel along the middle strip reserved for rapid traffic during the heavy traffic period.

It seems the general concensus of opinion that, until demonstrated uneconomic, the width, length and height of vehicles should be limited to 8 ft. 24 ft. and 12 ft. respectively.

Economic Value of Width

City pavements are expensive, and it is wise to carefully determine adequate width. Arbitrary standardization is wasteful. Pavement cost varies from 50 ct. to $1.00 per foot in width per lineal foot, or $2,500.00 to $5,000.00 per mile per foot in width. It is for this reason that the maximum width should be a minimum to accommodate the needs of the traffic and abutting property. Streets should not be paved too wide where use does not demand it. The regulation of width of vehicle is certainly justified in view of the added cost to accommodate a small percentage of extra wide trucks. The loss occasioned by congestion, detours, restricted business, etc., due to an inadequate roadway should be determined. This loss, when capitalized, indicates the sum that can be wisely spent to increase the roadway width or construct new trafficways adjoining, above or below the present street surface.

Sidewalks

The main purpose of the sidewalk is to accommodate the foot or pedestrian traffic. Other uses are incidental and can be ignored in determining the proper widths. The width of the sidewalk is often reduced by the presence of poles, hydrants, receptacles and building encroachments, usually stair entrances. The arbitrary, or "practical," rule for sidewalk widths on each side of the street is given by **the formula:**

$$\text{(V)} \qquad Sw = 2L$$

where Sw is the sidewalk width, in feet, on each side of the street, and L is the number of lines of traffic provided for the roadway.

The traditional method of determining sidewalk width is to make Sw from 8 to 20% of the total street width. A line of pedestrian traffic is universally taken as 2 ft. in width. It is obvious, therefore, that the **effective** sidewalk width should be a multiple of 2*.

In large cities the matter of adequate sidewalk width is vitally important. A formula can be developed for sidewalk width similar to the one used for roadway width. The width for one line of pedestrian traffic is taken as 2 ft. This includes allowance for clearance at the average speed of .5 to 3 mi. per hour. The distance apart (headway), is determined by speed, or rather degree of congestion, and comfort.

TABLE II.—ROADWAY, SIDEWALK AND STREET WIDTHS

Class of Street	No. of Traffic Lanes	Probable Length of Vehicle	Probable Maximum Width of Vehicle	Maximum Speed Allowed	Probable Average Speed	Maximum No. of Vehicles per Hour (No Parking)**	Roadway Width	Sidewalk Width (Each Side)	Parkway or Reserve Width (Each Side)	Minimum Total Street Width (Between Buildings)
Residence street	2	16	7	20	15	1,600	20–24	4–6	9–12	‡50–60†
Residence street	3	16	7	20	15	2,400	30	6	12	66†
Boulevard	6	14	7	30	20	3,270	56	10	22	120
Business street	4	16	8	20	10	2,200	40–48	12	28–24*	120*
Through route business street (car line)	6	20	8.5	20	10	3,180	60	16	0–14*	92–120*
Retail business street (car line)	8	16	8	15	5	3,520	80	20	0	120
Industrial street	4–6	24	8.5	10	3	1,440–2,160	44–68	10	0	64–88
Outlying drive or road	2	14	7	30	20	1,200	20	4	16	60

*Allow for future traffic increases. †Where zoning laws are in effect and character of street is settled. Otherwise require reserve space by establishing 30-ft "building lines." ‡Side frontage street for local traffic only (no parking). **Where parking is permitted reduce capacity to correspond with number of lines of moving traffic.

The following formula shows capacity of walk per 2 ft. of width at various rates of travel for various distances apart:

$$\text{(VI)} \qquad N' = 5280 \frac{M'}{H'}$$

where N' is the maximum number of pedestrians per hour per line of traffic (2-ft. width); M' is the average speed in miles per hour; and H' is the headway or distance between bodies (2 ft. for body).

$$\text{(VII)} \qquad Sw = \frac{2T}{N'}$$

in which Sw is the width of sidewalk in feet, and T is the total number of pedestrians passing per hour.

In a congested street, due to frequent interruption by cross traffic, etc., with an average speed of 1 mi. per hour and distance between pedstrians of 6 ft., we find

$$N' = \frac{(5280)(1)}{(6 + 2)}$$

or 660 persons per hour per 2 ft. of width, or 330 per hour per foot of width. This is approximately the maximum, since the clearance (for comfort) varies nearly directly as the speed.

City Planning

The importance of street and roadway widths is now quite well understood by students of city planning. The proper development of property as well as the enjoyment of community life, is dependent on the street layout.

Let us trace the history of street widths in the average American city. The universal street and road width east of Ohio is 66 ft., an arbitrary unit based on the "surveyor's chain," this unit being adopted to facilitate computation of areas in terms of acres, rather than from any consideration of traffic needs. This traditional or "standardized" width is inadequate in many places and wasteful in others. Many streets are laid out with the width based on willful expediency or vague imagination, no thought apparently being given to the needs of traffic; accessibility, need of parkways, or future use of the street.

The general rule for adequate **street** width is given by the simple formula:

$$W = WR + Ws + Wp + Wg$$

in which W is the total width between buildings; WR is the necessary width of roadway; Ws is the

(Concluded on page 24)

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*See article by the author in "Engineering & Contracting," Nov. 22, 1911, page 562.

Highway Researches and Their Results-III *

Need of Information on Behavior of Various Pavement Types on Different Subgrades and for Data as a Basis for Rational Pavement Design—Description of Series of Tests and Studies being Conducted by the U. S. Bureau of Public Roads

By A. T. GOLDBECK†

(Concluded from July 6)

Drainage Investigation

No soil investigation would be complete without a study of methods for adequately draining the subgrade. It is a well-known fact that many roads have failed on fills as well as in cuts when the soil has been of a particular type. It is also a well-known fact that some soils are not susceptible to drainage such as might be used on other types of soils. We have seen subgrade failures throughout the country where drainage was employed. We have ever before us the constant example of city pavements of comparatively light cross-section very successfully carrying extremely heavy loads, and we are forced to the conclusion that perhaps many of our so-called drainage systems are not as immediately effective as they should be at the time when most needed, in the spring of the year.

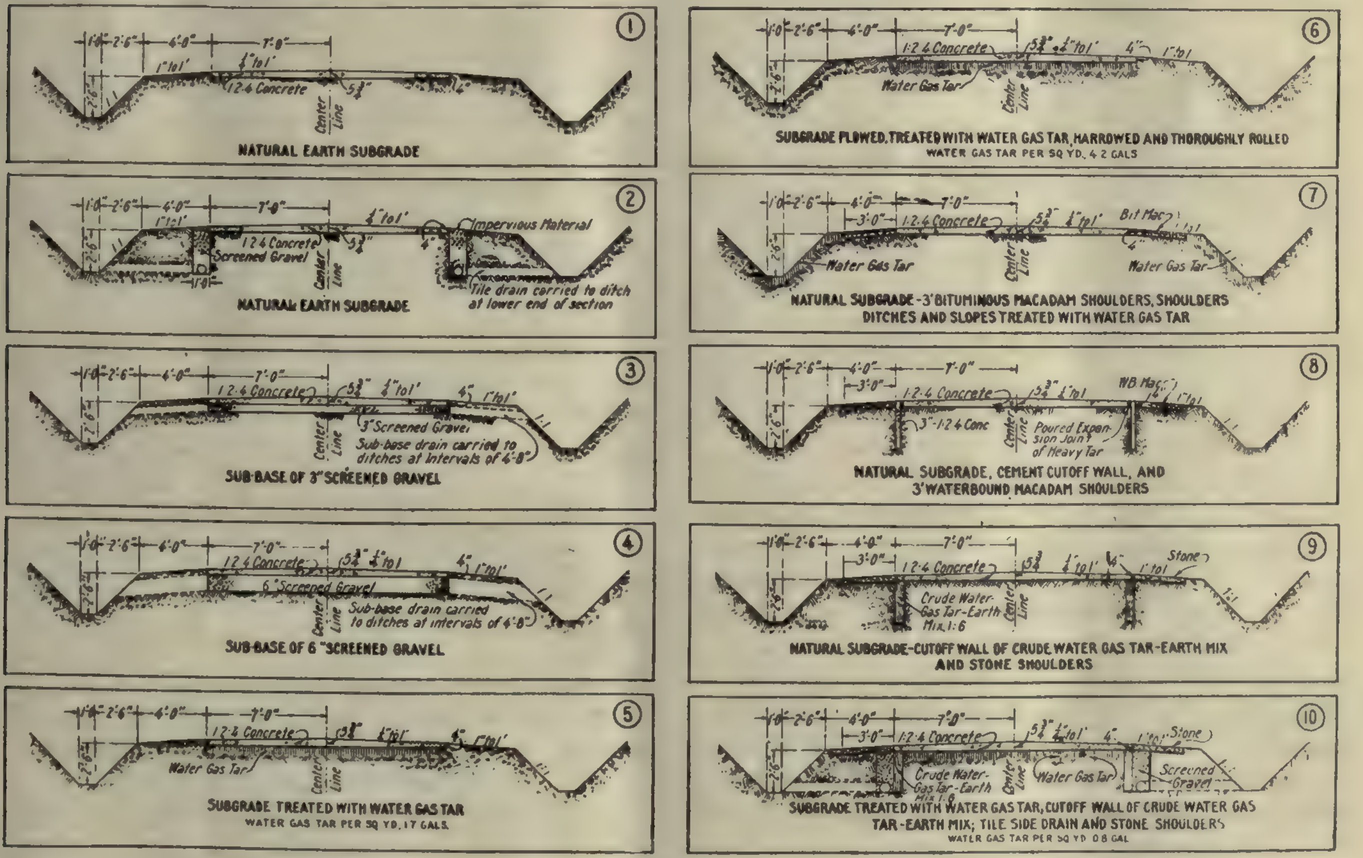
①
1:2:4 Concrete
Center Line
NATURAL EARTH SUBGRADE
②
Impervious Material
1:2:4 Concrete
Screened Gravel
Tile drain carried to ditch at lower end of section
NATURAL EARTH SUBGRADE
③
1:2:4 Concrete
3" Screened Gravel
Sub-base drain carried to ditches at intervals of 4'-8"
SUB-BASE OF 3" SCREENED GRAVEL
④
1:2:4 Concrete
6" Screened Gravel
Sub-base drain carried to ditches at intervals of 4'-8"
SUB-BASE OF 6" SCREENED GRAVEL
⑤
1:2:4 Concrete
Water Gas Tar
SUBGRADE TREATED WITH WATER GAS TAR
WATER GAS TAR PER SQ YD. 17 GALS.
⑥
1:2:4 Concrete
Water Gas Tar
SUBGRADE PLOWED, TREATED WITH WATER GAS TAR, HARROWED AND THOROUGHLY ROLLED
WATER GAS TAR PER SQ YD. 4 2 GALS
⑦
1:2:4 Concrete
Bit Mac
Water Gas Tar
NATURAL SUBGRADE-3' BITUMINOUS MACADAM SHOULDERS, SHOULDERS DITCHES AND SLOPES TREATED WITH WATER GAS TAR
⑧
1:2:4 Concrete
WB Mac
3"-1:2:4 Conc
Poured Expansion Joint of Heavy Tar
NATURAL SUBGRADE, CEMENT CUTOFF WALL, AND 3' WATERBOUND MACADAM SHOULDERS
⑨
1:2:4 Concrete
Stone
Crude Water-Gas Tar-Earth Mix 1:6
NATURAL SUBGRADE-CUTOFF WALL OF CRUDE WATER GAS TAR-EARTH MIX AND STONE SHOULDERS
⑩
1:2:4 Concrete
Stone
Crude Water-Gas Tar-Earth Mix
Water Gas Tar
Screened Gravel
SUBGRADE TREATED WITH WATER GAS TAR, CUTOFF WALL OF CRUDE WATER GAS TAR-EARTH MIX; TILE SIDE DRAIN AND STONE SHOULDERS
WATER GAS TAR PER SQ YD 0.8 GAL

FIG. 12

Our curiosity has been aroused as to whether some sort of drainage system which will exclude the water from the subgrade should not be designed. Our present drainage systems, it would seem, are built to carry the water away from the subgrade after it has had a chance to make the soil thoroughly wet and soft. In Fig. 12 will be observed a series of drainage experiments which have been started at Arlington Farm in an effort to determine some principles underlying the drainage of subgrades. This, in itself, is a big subject and cannot be covered in the time allotted. Some of these experiments are designed to determine the effect of waterproofing the subgrade by use of waterproofing materials; others are intended to demonstrate the action of sub-bases of porous materials. Some of the other sections aim to exclude the water by impervious walls built along the slab. Provided these experiments prove successful, we hope to carry them out on a large scale with the aid of the state highway departments. Our

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*Paper presented at the 1921 Convention of the American Road Builders' Association, Chicago, Ill.

†Engineer of Tests, U. S. Bureau of Public Roads.

criterion of success is the per cent. of moisture in the subgrades under the various experimental sections. We take samples of the soil under these slabs through openings in the slabs and that section showing the driest subgrade may be considered as most effective. By next spring we shall know if any of the schemes are of any value. The present indications are that we shall obtain greatest success from the section containing the underlying layer of gravel. Such a layer probably aids in keeping the subgrade dry through aeration and, in addition, distributes the load concentrations to the soft subgrade.

Accelerated Wear Tests

There is one investigation which we have mentioned very little up to the present time although the investigation has been under way for seveal years. I refer to what might be called an accelerated wear test. We have constructed a stretch of pavement about 400 ft. long and 2 ft. wide, made up of 49 short sections of different types of pavement. In constructing this test section concrete side walls were laid along both sides along the entire length of the pavement, spaced 2 ft. apart inside to inside. Eighteen inches of compacted cinders were laid as a subfoundation and the subgrade under this was tile drained throughout the length of the pavement. The following pavement sections were then laid, all of the sections except the concrete wearing surface being laid on an 8-in. 1:3:6 concrete base. The concrete sections were only 6 in. in thickness.

Over these sections of pavement a special type of wearing device was hauled back and forth by means of a steel cable operated by means of a stationary engine. The wearing machine consists of five large cast iron wheels, each weighing 1,000 lb. with a 2-in. width of wearing face. Three of these wheels are arranged side by side, with spaces of 3 in. between them. The other two wheels run side by side in the spaces between the three other wheels. Each wheel is independent of all other wheels, and its entire weight rests upon the road surface. As these wheels have a small amount of lateral play, practically the entire 12-in. strip is subjected to wear. This test was designed primarily as a test for granite paving block, which are used in municipal construction where there is still a high percentage of heavy steel-tired traffic. The idea of testing the various other types of pavements was an afterthought, and in view of the fact that these other types are not in general used on the same basis as granite block, it is not our intention in any way to make a comparison of the different materials on the basis of this test.

Another feature of the test which must be pointed out in order that there may be no misinterpretation of the results is that the width of the pavement is only 2 ft. This is a very much narrower strip than supports the load in an actual pavement. Owing to this fact and to the fact also, that this narrow strip supports three 1,000-lb. weights placed side by side and 6 in. on centers, and coupled also with the fact that the full force of these weights is exerted on the road surface since they are all unsprung, the pavement sections are subjected to far greater bending stress than are pavements in actual practice; and also, to much higher unit pressure on the subgrade.

No comparison should be made of the relative cracking of brick pavements as compared with the concrete sections because the concrete sections were only 6 in. in depth, whereas, the brick sections, as well as the stone block sections, were laid on an 8-in. concrete base, making a total thickness of pavement practically double that of the concrete. These facts are stated to show why no fair comparison can be drawn between the pavements having different wearing surfaces, since unfortunately they were not built on a comparable basis. Comparisons can be drawn, however, between the various sections having the same kind of wearing surface but having different qualities of wearing surface and different design. A detailed consideration of the results of this test is impracticable in the present discussion, but several papers giving detailed results are now practically completed and will be published in coming issues of Public Roads. The table on the next page and the following table outline the various sections under test in this investigation:

Sec.	AGGREGATE		SECTION	
No.	Kind	Size	Thick	Length
1	Trap Rock	2" — ¾"	6"	16.5′
2	Limestone	¼"—2½"	6"	9.0′
3	Gravel	¼"—1½"	6"	11.2′
4	Sandstone	½"—2½"	6"	10.5′
5	Slag	¼"— ¾"	6"	11.1′
6	Gravel	¼"—1½"	6"	12.0′
7	Slag	¼"—2½"	6"	7.2′
8	Gneiss	1½"— ¼"	6"	12.5′

Considering the result indicated by this test and without going into detail regarding the types of failures, the following are tentative indications:

Stone Block Sections

1. Bituminous fillers and Portland cement grout fillers are equally effective in preventing breaking down of edges in this test.

2. Bituminous mastic fillers seem to offer as much protection to the block as straight bituminous fillers.

3. The effect of impact is tremendously increased by irregularities produced by poorly cut block.

4. Irregularities of the surface which cause impact were more serious with grout fillers than with bituminous fillers.

5. Slight variations in the coefficient of wear (such as occur throughout the range of the commercial granite block quarries of the Atlantic Coast) are of much less importance in judging the probable resistance of the block to the action of traffic than has been commonly supposed.

Brick Sections

1. This test brings out very clearly the great value of the rattler test for indicating the quality of paving brick.

2. Soft brick producing incipient failure resulted in more rapid ultimate failure than if all brick had been uniform. Under steel-tired traffic uniformity is desirable.

3. Owing to the large variety of the sections, the relative condition can best be expressed by the following table which must be studied, in order to arrive at the relative worth of the sections after the indicated number of trips of the wearing device:

	SECTIONS																				
Runs	1	7	2	8	3	9	4	10	5	12	6	11	20	13	14	21	15	16	17	18	19
125																					T
625									T	T	T	T				T					S
1150					T	T	T	T			S						T	T	T	T	
1650													T							S	
2150	T	T	T	T					S			R		T	T				S		F
2650		R			S					R						S					
3250																					
3750								R			F					F		W		F	
4650					F	S			F								W				
5000																			F		

T—first trace; R—non-uniform rutting; S—non-uniform shear and shattering; W—non-uniform wear; F—total failure.
T—1, 8, 2, 4-13, 14, 20; W—16, 10, 7, 9, 15, 12, 11; F—17, 6, 3, 5, 18, 21, 19.

Sec. No.	BRICK		CUSHION		Length, Sec.	JOINT FILLER
	Type	%Wear	Material	Thick.		Material
1	Repressed	16	Sand Cem. 4:1	1″	8′	Grout 1:1
2	Wire cut lug	16	“ “ “	1″	8′	“ “
3	Repressed	19	“ “ “	1″	8′	“ “
4	Wire cut lug	19	“ “ “	1″	8′	“ “
5	Repressed	24	“ “ “	1″	8′	“ “
6	Wire cut lug	24	“ “ “	1″	8′	“ “
7	Repressed	16	“ “ “	1″	8′	Asphalt
8	Wire cut lug	16	“ “ “	1″	8′	“
9	Repressed	19	“ “ “	1″	8′	“
10	Wire cut lug	19	“ “ “	1″	8′	“
11	Repressed	24	“ “ “	1″	8′	“
12	Wire cut lug	24	“ “ “	1″	8′	“
13	Vert. fibre	18.8	“ “ “	1″	8′	“
14	“ “	18.8	Sand	1″	8′	“
15	3″ wire cut lug	17.7	“	1″	8′	“
16	“ “ “	17.7	“	1″	8′	Asphalt Mastic 1:1
17	“ “ “	17.7	“	1″	8′	Tar
18	“ “ “	17.7	“	1″	8′	Tar Mastic 1:1
19	“ “ “	17.7	“	1″	8′	Grout 1:1
20	Wire cut lug	16	“	1″	8′	Tar
21	Vert. fibre	18.8	Sand Cem. 4:1	1″	8′	Grout 1:1

Sec. No.	GRANITE BLOCK	CUSHION		Length, Sec.	JOINT FILLER
	Source	Material	Thick.		Material
1	Vinal Haven	Sand Cem. 4:1	1″	8′	Grout 1:1
2	Rockport	“ “ “	1″	8′	“ “
3	Mt. Airy	“ “ “	1″	8′	“ “
4	Chelmsford	“ “ “	1″	8′	“ “
5	Concord	“ “ “	1″	8′	“ “
6	Cape Anna	“ “ “	1″	8′	“ “
7	Lithonia	“ “ “	1″	8′	“ “
8	“	“ “ “	1″	8′	Asphalt
9	Vinal Haven	“ “ “	1″	8′	“
10	Rockport	“ “ “	1″	8′	“
11	Mt. Airy	“ “ “	1″	8′	“
12	Vinal Haven	“ “ “	1″	8′	Asphalt Mastic
13	Chelmsford	“ “ “	1″	8′	“ “
14	Concord	“ “ “	1″	8′	“ “
15	Somes Sound	Sand	1″	8′	Asphalt
16	Long Cove	Asphalt Mastic	1″	8′	Asphalt Mastic
17	Vinal Haven	Sand Cem. 4:1	1″	8′	“ “
18	Somes Sound	Sand	1″	8′	Tar
19	Long Cove	Tar Mastic	1″	8′	Tar Mastic

Concrete Sections

The concrete sections were laid primarily to study the differences in the wearing qualities produced by different grades of coarse aggregates. Owing to the narrowness of the test sections, the high load concentrations, the resulting high unit pressure upon the subgrade, and the little resistance to bending offered by the thin concrete slabs, transverse cracks were numerous in the concrete. The following remarks indicate the relative condition of the concrete sections after 5,730 trips of the wear machine:

1. Trap rock, ¾ to 2 in.
   Uniform grooving, maximum depth ⅛ in.
2. Limestone, ½ to 2½ in.
   Non-uniform wear, maximum depth ¼ in.
3. and 6. Gravel, ¼ to 1½ in.
   Fairly uniform wear; maximum depth ¼ in.
4. Sandstone, ½ to 2½ in.
   Non-uniform wear, maximum depth ¼ in.
5. Slag, ¼ to ¾ in.
   Fairly uniform wear, maximum depth ½ in.
7. Slag, ½ to 2½ in.
   Non-uniform wear, maximum depth ½ to ⅝ in.
8. Gneiss, ¼ to 1½ in.
   Uniform grooving, maximum depth ⅛ in.

(Concluded on page 25)

Urban and Interurban Motor Bus Service*

Four Cardinal Principles of Motor Bus Operation: Supervision by Public Utility Commissions; Operation Under License Instead of Franchise; Competent Control of Physical Characteristics of Vehicles, and Enforcement of Responsibility of Operator

Your Committee on "Urban and Interurban Motor Bus Service" herewith presents a progress report, in which there have been outlined certain principles that should underlie the policy of this association in advocacy of the establishment or extension of motor bus services on the public streets and highways:

1. Public transport by motor bus is a public utility service and should be so classed wherever and however conducted, and should be clothed with all the privileges and responsibilities appropriate to such enterprises. Where public utility commissions exist, they should have supervision of the financing, accounting, equipment and service, and should permit operation only after securing a practical knowledge of the situation and the issuance of a certificate of convenience and necessity.

THE MOTOR BUS HAS NOT MADE GOOD IN THIS COUNTRY. EVEN IN THE CITY OF NEW YORK, as it has in some places, notably in London. How much this is due to unreasonable restrictions imposed upon it, how much to lack of initiative on the part of those equipped to enter the field of motor vehicle passenger transportation, and how much to other causes are questions worth discussing, for the motor vehicle has great possibilities as a commercial passenger carrier. Some of the angles of the question of motor bus service in this country are viewed through experienced eyes in the subjoined report.

2. The fixed capital necessary for the operation of a motor bus service being practically liquid in character, franchises for operation are generally unnecessary and usually undesirable. A license, revocable for cause issued under the terms of a general motor bus law or ordinance, is all that is necessary. The license fee should be sufficient to produce the revenue necessary for efficient supervision, and no more. The simpler the procedure for securing authority to operate, and the freer that authority is from artificial and hampering restrictions, the better and cheaper service the operator can give. Neither is a monopoly, technically speaking, either necessary or desirable. While it is true that, in the hands of a strong, capable, enterprising operator, under proper control, the best results—from the public viewpoint—are obtained by a unified service within a given field, yet such a condition may be secured under the operation of the requirement of a certificate of necessity, and the situation can then be controlled at all times strictly upon its merits.

3. The character, design, weight and dimensions of the equipment employed in motor bus service should be prescribed or controlled by some competent authority acting according to the most enlightened standards. This is essential in order to protect the public, whether as passengers or as users in common of the streets and highways, as well as for the protection of the pavement of the roadway itself. Vehicles that constitute an inordinate obstruction to other vehicular traffic, or cause undue wear and tear on the pavement, should not be permitted. Weight should be limited to an amount sufficient to safely accommodate the number of passengers for which seats are provided **and no more.** Brakes should be correctly designed and efficient in practice, with adequate braking surfaces and capable of easy adjustment. Stability should be assured.

4. The public should be protected, not only as to safety of passengers and other users of the streets, but also against irresponsibility of the operator in the event of accident or damage to persons or property. Where a responsible operator is not in control, a liability bond should be required.

The above principles embody some of the observations made during an experience of about fifteen years in the organization and management of motor bus services. During that period I have come to the firm belief that the license system of authority, as most notably exemplified in London, is by far the best basis for motor bus operation, and that the sooner and more extensively it is established in this country, the sooner the motor bus, as a serious, responsible method of transportation, will come into its own and the public reap the benefit of better and more comfortable service. In London only, of all the cities in the world, has the motor bus had the opportunity to develop on its merits and free from artificial restraint. The splendid results obtained there are the best evidence that the environment is a healthful one for such an enterprise and that responsible operators do not need exclusive franchises for long periods in order to protect their investment, provided only that they are able and willing to supply good and adequate service in the field they select.

The companies with which I have been connected have enjoyed to an uncommon extent the good will

(Concluded on page 25)

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*Report of the National Committee on Urban and Interurban Motor Bus Service, of the National Highway Traffic Association, presented at the annual convention, Detroit, Mich., April 29, 1921.

Presented by R. W. Meade President of the Detroit Motorbus Co., Chairman.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

Founded January, 1892

E. L. POWERS
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HOW WIDE IS A ROAD?

How wide to build roads and streets always has been, and is, a vexed question.

Safety requires ample width; economy calls for reduction to the least possible. Somewhere between the two lies the desired mean.

Elsewhere is this issue is an exhaustive discussion of width of city streets and sidewalks, in which it is pointed out that: "The securing of adequate roadway and sidewalk widths is one of the most important problems in the modern city."

Three weeks ago there was presented in "Good Roads" a study of the subject of widths of main roads, in which the author reached the conclusion that: "Any highway plans contemplating an extended system of highways constructed for a greater width than required by two lines of traffic are extravagant."

These two articles cover the subject of highway widths—one for city streets and the other for country roads—except for the country roads of less importance than those included in state highway systems. It is not likely that all highway engineers will agree entirely with the conclusions reached in either of them.

Irrespective of the merits of the arguments set forth in either of the articles, they both serve to focus attention upon a subject in much need of further study. There are many roads—and even more streets, perhaps—that are too narrow for safety or comfort. There are others that are too wide, many that are wider than necessary for two lines of traffic but not of sufficient width to accommodate three lines safely. If the excess pavement on the sides of the latter were added at the ends, the public would have a considerably greater mileage of good roads without additional expenditure.

WHY PICK ON THE STATE HIGHWAY OFFICIALS

Some rather uncomplimentary allusions to state highway commissioners were made by Senator Wadsworth of New York in a speech in the Senate a week or so ago. His aspersions seem to have little foundation in fact.

It appears that the Senator from New York objects to the distribution of surplus war materials—specifically, motor trucks—that has been made to the states. He claims the War Department has disposed of so many that it is short itself, and intimates that the prospect of free motor trucks arouses unholy desires in the hearts of highway commissioners.

Since there are always two sides of a question, there are probably some good arguments against the wholesale gifts of motor trucks and other equipment to highway departments. But, so far as we have been able to learn, the machinery turned over to state and other highway departments since the termination of the war has been put to good use and has enabled many communities to do work that could not have been done otherwise.

UNIFORM OR FEDERAL MOTOR VEHICLE LAWS

The need of uniformity in motor vehicle laws, secured either by taking the matter out of the control of the separate states and vesting all authority in the Federal Government or by devising some workable plan of cooperation among the states, is again emphasized by the controversy between New York and New Jersey that has recently been brought to an amicable settlement.

The trouble arose from the dissimilarity between the laws of the two states relative to the operation of automobiles. In New York State a driver must be 18 years old; in New Jersey he must have attained the ripe age of 16. Not long ago a Jersey youth between 16 and 18 drove over into New York, got himself into the clutches of the law and was convicted by a New York State justice of the peace.

New Jersey officials retaliated some weeks later, justifying their activities by the New York laws regulating operation. These are somewhat confusing, in that car owners are required to have operators' licenses only if they are residents of New York City, or if—they live elsewhere in the state—when they operate their cars within the confines of the Greater City. The reprisals by the Jersey officials consisted of holding up all New York cars passing the police station at Kearney, demanding to see the car and operators' licenses, and arresting all motorists who couldn't produce both.

That the differences between the two states were finally adjusted by a renewal of promises to respect each other's laws is beside the point. The important thing is that the regulations—be they state or federal—should be such that a motor vehicle operator has at least a fighting chance to keep within the law. Under existing conditions he may do his best yet automatically become a law breaker the minute he crosses a state line. And the line between New York and New Jersey is only one of many where that very thing happens.

Governor of Illinois Signs Road Laws

Governor Len Small of Illinois on June 24 signed road bills appropriating $53,000,000 for highway work. These bills embrace appropriations of $20,000,000 to meet federal aid, $30,000,000 of the state road bond issue and $3,000,000 for maintenance of highways.

Roadway and Sidewalk Widths

(Concluded from page 18)

necessary width of sidewalks (both sides); *Wp* is the width of parkway (both sides); and *Wg* is the reserve width, or width necessary to widen roadway and sidewalk when character of street and property changes. Very often *Wg* is taken equal to *Wp*. the parkways being absorbed later on in the roadway and sidewalk space. In some cases *Wg* is laid out between the sidewalk and so-called building line. This is good practice where legal, and later on, enforcable. (See Table II).

This table is submitted to show approximate roadway, sidewalk and street widths required for modern traffic for usual types of streets, in the average municipality. This table does not represent an attempt at standardization. It appears here to indicate the proper method of determining total street width, which should, if possible, be secured when the street is originally plotted.

It is still the general custom to determine roadway width on the basis of limitations of site and cost. While this method may be warranted in a few cases, it should be generally discouraged. Some cities have attempted a general standardization by assigning ratios to the roadway or sidewalk width. Usually the roadway width is established at 40, 50, 60 or even 70% of the total street width. There should be no general standardization of roadway or sidewalk widths. As stated before, the width should be an expression of the use of the street or the needs of the traffic and abutting property. Each street should be studied not only alone but in connection with the general street plan, and widths adopted to fit its use. City planning, with its provision for zoning, will greatly assist in defining the character of the street, and thus enable us to design street and sidewalk and roadway width more efficiently in the future.

Injunction Halts Work on Ohio Road

Holding that the law requiring the State Highway Commissioner of Ohio to let bids within ten days after the bids are opened for road work is mandatory, an injunction has been granted against Commissioner Herrick and two contractors with a road contract in Wyandot County. Henry P. Streicher, who asked for the injunction, claimed to have been low bidder for the contract last October, but all the bids were thrown out. A second letting was held in November and the contract, it is alleged, was awarded after the ten days has elapsed.

Dowell Bill Referred to Senate Committee on Roads

The Phipps-Dowell Bill, which passed the House by an overwhelming majority, was sent to the Senate and has been referred to the Senate Committee on Post Offices and Post Roads. Although this committee has been instrumental in stopping federal aid appropriations, Senator Townsend, its chairman, has stated this bill will not be pigeon-holed. In view of the opposition which was manifested in the Senate against the changing of the present federal aid administration, it may be possible that Senator Townsend will relinquish his plan of a federal highway commission. If this is done, there ought to be no delay in securing federal aid appropriations.

Oregon Will Spend $100,000,000 on Roads Within Next Ten Years

Commissioner Booth Says State Can Complete System with Motor Fees

"Within the next decade there will have been expended for roads in Oregon the sum of $100,000,000, of which the Federal Government will have contributed approximately 25%, the state 45% and the counties the remainder," said A. R. Booth, Chairman of the State Highway Commission, at a recent meeting in Eugene, Ore.

"Oregon already has expended $28,000,000 on road construction, which, with contracts outstanding amounting to $13,000,000, will make a total of $41,000,000."

There are 4,500 mi. of road in the present state highway system, Mr. Booth said, and of this total 3,000 mi. have already been paved or graded. The revenues in sight, continued the commissioner, allowing for reasonable increase in automobile registrations, will support bond issues sufficiently to complete the state system of highways, which can be completed within the present bonding limit of the state constitution.

Highway Researches and Their Results

(Concluded from page 21)

Disregarding cracks, the above sections in their resistance to wear seem to rank 1-8, 3-6, 2, 4, 5 and 7.

Apparently, so far as resistance to cracking and resistance to wear about cracks are concerned, the sections rank 8, 1, 7, 5, 2, 6-3 and 4.

The resistance to wear in the Deval abrasion test of the above crushed coarse aggregate is as follows:

	Percent Wear
Sandstone—Roane Co., W. Va.	8.9
Trap—Loudoun, Va.	2.6
Limestone, Jefferson Co., W. Va.	4.5
Granite—Arlington Co., Va.	4.0
Gravel—Potomac River	12.0*
Slag	—

*Gravel abrasion test.

It will be impossible to state the coefficient of wear of the gravel in the same terms used for the crushed rock.

In conclusion, it should be stated that the indications resulting from the various test results obtained can in no sense be regarded as final and definite conclusions, although some of the indications will no doubt be borne out very definitely in service. As pointed out in the introductory remarks, the results of accelerated tests in general are not to be accepted as final, but they have a very useful purpose in serving to further guide our judgment and in leading us more quickly into approximately correct design. Those investigations which aim at the establishment of fundamental principles, such, for instance, as the determination of the amount of impact exerted by motor trucks on roads undoubtedly have already established facts which if carefully analyzed will point to procedure resulting in economy in our transportation and highways. As more and more data are accumulated from various investigations, I feel that we are being led more and more into the correct principles of design and more and more into the closer adjustment between the highways and the transportation units. Let us hope that within a few years this adjustment will have been effected and that our system of transportation by motor truck shall have been worked out in such a way that there will result the greatest economy in haul by motor truck.

THE END

Urban and Interurban Motor Bus Service

(Concluded from page 22)

of the public. This has resulted largely through the adoption of policies and practices that—at least in the beginning—were regarded by practical transportation men as idealistic and unsound. Take, for example, the rule, voluntarily imposed, limiting the number of passengers strictly to the seating capacity. It has been the cornerstone of the sucess of the companies that have adopted it and has differentiated them sharply from the long list of motor bus failures and from the "jitney."

Again, conservative restrictions, self imposed, on the weights and dimensions of our motor buses have been important elements of sucess. Where other designers of motor bus equipment have seemed to vie in producing the largest and heaviest things that would run on wheels, we have restricted ourselves as nearly as practicable to the London weights and dimensions, which, wisely, provide just enough weight and space to accommodate the load safely.

The average operator will not voluntarily restrict himself in these respects and it therefore becomes necessary, in the interest of the public welfare, to do so for him. In the beginning, the restrictions imposed by the Metropolitan Police authorities of London on motor bus design were resented by the operators, but their wisdom has been demonstrated so effectively by years of experience that no one would now change the policy, though modifications have recently been granted in detail.

If America wants to get away from the fly-by-night, irresponsible "jitney" and secure good, responsible motor bus service, the laws must be so molded as to protect the responsible operator and discourage the pirate. This association, it would seem, may be the proper vehicle to blaze the way in this direction.

Road Work in North Carolina

Counties Build State Roads and Will be Reimbursed Later by State

The North Carolina State Highway Commission plans to build 482 mi. of highway at a cost of over $7,000,000 as rapidly as possible. Since the reorganization of the commission, following the enactment of new road legislation at the last session of the General Assembly, the commission has approved projects for more than 1,000 mi. of road involving an expenditure of $18,000,000.

Under the Guilford-Forsyth resolution, counties desiring the immediate construction of roads, may build them under the supervision of the state, the state letting the contracts and the counties paying for the work. It is provided that the state will reimburse the counties when bonds are sold or other funds become available. Several counties have undertaken the construction of state roads under this arrangement. In the Sixth District the Charlotte-Statesville Road will be hard surfaced for a distance of 43 mi. under this arrangement.

◆

The County Engineer of Hill County, Texas, has been indicted on the charge of accepting and offering bribes. A commissioner of the county has been indicted on the charge of accepting a bribe of $5,000 in connection with a road contract.

EQUIPMENT--TRADE--MATERIALS

Avery "Road-Razer"

A new machine, designed particularly for the maintenance of earth roads but adaptable to many other uses, has lately been put on the market. The "Road-Razer," as it is called, is shown in the accompanying illustrations which show front and rear views of the machine and of the road before and after its passage.

The machine consists of a gasoline engine mounted on a 3-wheeled chassis underneath which a cutting blade is suspended. The special features of the machine are the combination of power plant and blade in one self-contained unit, the 3-section flexible blade, its turning mechanism, and the one-man control.

The power plant consists of a 6-cylinder motor with a 3-in. bore and a 4-in. stroke. The transmission is of the selective sliding gear type, having three speeds forward and one reverse. In low, the machine travels 1½ mi. per hour; in intermediate, the working speed, 2⅛ mi., and in high, 4¼ mi. per hour. The reverse speed is 1½ mi. per hour. The intermediate speed is by direct drive.

The blade consists of one 2½-ft. and two 5-ft. sections, overlapping at hinged joints and forming one adjustable cutter. It is hung diagonally under the machine, with a clearance of 10 in. in front of the right drive wheel and 10 in. back of the left drive wheel. The blade is 13 in. high and ¼ in. thick, with a cutting edge 5 in. wide, which is detachable and reversible. The effective width of the cut is 9 ft. 6 in.

The short section of the blade is at the right-hand side, so permitting adjustment to shoulder or ditch slopes. Adjustments of the blade to fit the contour of the roadway are made while the machine is in operation by means of levers within easy reach of the operator.

The single steering wheel at the front of the machine and the brake control of the driving wheels permit turning the machine around by pivoting on either driving wheel. To accomplish this operation the steering wheel is released and one of the driving wheels locked by means of the differential brake. This allows the steering wheel to act as a caster while the machine pivots on the locked driver.

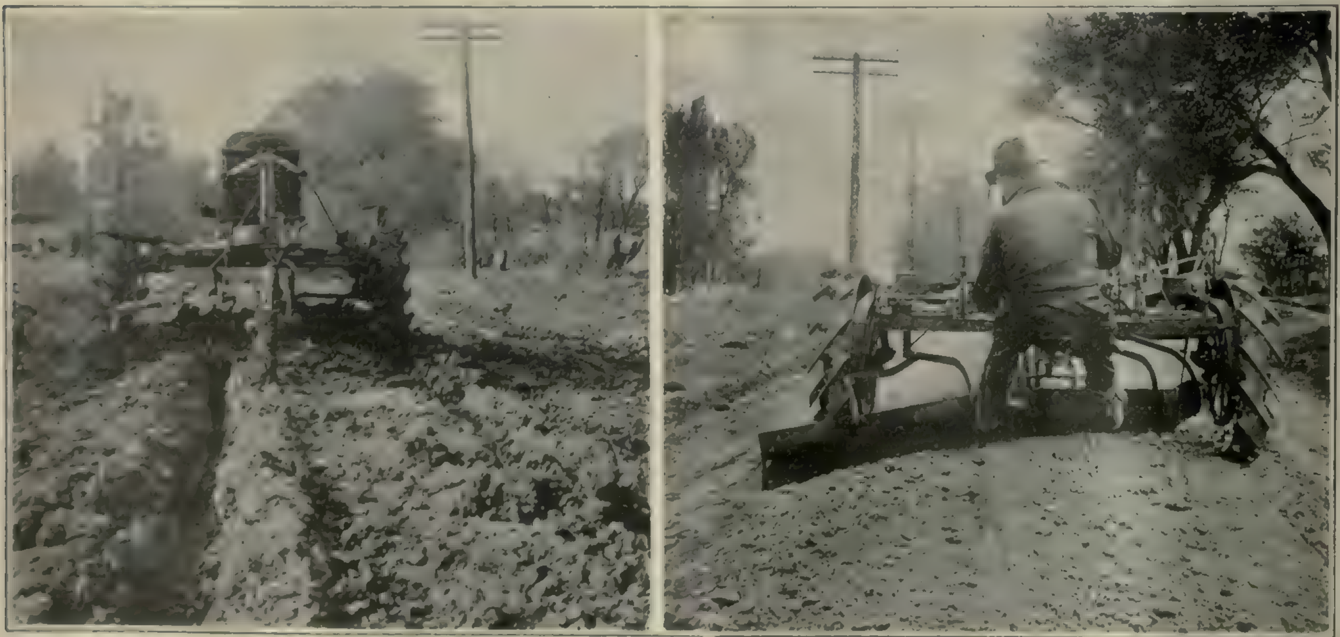
All operations are controlled by one man from the seat at the rear of the machine.

The "Road-Razer" is manufactured by the Avery Company, of Peoria, Ill.

Catalog of Austin Rollers

A large illustrated catalog of the Austin line of gasoline (and kerosene) and steam rollers has recently been issued by the Austin-Western Road Machinery Co., of Chicago, Ill. The catalog contains 64 pages and in addition to describing the line of road rollers, gives short descriptions of some of the other Austin machinery, as scarifiers, graders, etc.

In relation to gasoline (and kerosene) motor rollers, the catalog points out that sufficient fuel can be carried in the roller's tank for a 10-hour run on



Front View (Before)—AVERY ROAD-RAZER—Rear View (After) full load. By the use of a comparatively small fuel tank trailer, several weeks' supply of fuel can be carried along with no trouble.

Easton Scoop Bodies for Ford Trucks

A self dumping body for Ford trucks has been brought out by the Easton Car and Construction Co., of New York, N. Y. This body, shown in the accompanying illustration, is made in seven sizes, to hold from ½ to 2 cu. yd. Because the body is low it is especially adapted to hand loading. The driver can trip and right the body from the seat.

EASTON SCOOP DUMP BODY

The body is made of ⅛-in. steel plates with smooth rolled and welded steel reinforcing flanges around the top. The bottom is heavily reinforced by angles. The sub-frame is made of channels securely fastened together.

Hercules Reduces Powder Prices

The Hercules Powder Co., Wilmington, Del., has announced a reduction in prices of dynamite, black blasting powder and blasting caps. It is also announced by the company that it will discontinue the manufacture of high freezing dynamites. This will permit the use of most of their straight dynamites without thawing.

The "Waughoist"

A portable hoisting machine called the "Waughoist," which will fit any 4 or 4½-in. column, is being marketed by the Denver Rock Drill Mfg. Co., of Denver Colo. This machine has a rotary compressed air engine and can be used in hoisting materials wherever compressed air is available. The "Waughoist" will lift 500 to 2,000 lb. at 100 lb. pressure vertically at the rate of 68 to 143 ft. per minute. The drum capacity is 755 cu. in. which will accommodate 1,000 ft. of ¼-in. rope.

Diamond T Contractors' Special

A new truck model designed for the use of contractors is being made by the Diamond T Motor Car Co., of Chicago, Ill.

This truck is equipped with dual dump hoppers constructed of 10-gage steel, each carrying 1 cu. yd. of material. These hoppers dump by gravity at an angle of approximately 60 deg. and are mounted side by side so as to dump from the rear of the truck.

The truck has a short wheelbase so as to turn easily on an 18-ft. subgrade. It is fitted with pneumatic tires and has a speed of 25 mi. per hour on high and 5 mi. per hour in reverse.

Du Pont Will Make Non-Freezing Dynamites

The Du Pont Company has developed a formula for the manufacture of straight dynamite which will not freeze at zero temperatures and will discontinue the manufacture of its former straight dynamite. While straight dynamite has been used extensively in all open work, it has had the disadvantage of freezing at temperatures below 50° F. The perfection of the new powder by the Du Pont Company makes it possible to use straight dynamite the year round in industrial operations. The new explosive has been thoroughly tested and proved and the formula for making it has been made standard in all the dynamite plants of the company.

Heil 1-Yd. Gravity Truck Body

A 1-yd. gravity truck body for mounting on Fords or other light trucks has recently been designed and placed on the market by the Heil Co., Milwaukee, Wis.

This body is made of 12-gage steel, electrically welded, and has few working parts. In the raised position the front of the body rests against body stops, and self locking hooks hold it in this position. When the body is released it tips backward with a dumping angle of 80 deg. The driver is able to

HEIL GRAVITY DUMP BODY

trip the body without getting out of the cab. Heavy control springs on the control rod stop the travel of the body without any decided jerk on the chassis and help to throw the body back into the raised position.

These bodies can readily be attached to any chassis by means of four U-bolts, which are furnished. The body sells for $100 f. o. b. Milwaukee.

Smith Snapshots

A new magazine with the above title has been issued by the T. L. Smith Co. in the interest of engineers and contractors. The magazine contains numerous articles on the actual use of labor saving machinery on specific jobs. In the April issue the leading article is entitled, "How Will You Pave in 1921?", being a detailed discussion of the use of a 1-yd. tilting mixer in use at a central mixing plant on a road job.

MEETINGS

Calendar of Coming Meetings

Aug. 30-Sept. 1—Michigan State Good Roads Association.—Annual meeting, Flint, Mich. P. T. Colgrove, Pres., Hastings, Mich.

Oct. 24-28—American Society for Municipal Improvements—Annual Convention, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Society for the Promotion of Engineering Education

The 29th annual meeting of the Society for the Promotion of Engineering Education was held on June 28 to July 1 at Yale University, with an attendance of about 280 members, with 72 institutions represented. The following officers were elected: President, Charles F. Scott, of Yale; Vice Presidents, H. J. Hughes, of Harvard, and E. J. McCaustland, of the University of Missouri; Secretary, F. L. Bishop, of the University of Pittsburgh; Treasurer, W. O. Wiley, of New York City; members of the council, P. H. Daggett, of the University of North Carolina, J. H. Dunlap, of the University of Iowa, M. L. Enger, of the University of Illinois, J. C. L. Fish, of Leland Stanford University, F. E. Gieseke, of the University of Texas, Morris Knowles, of Pittsburgh, Pa., and O. M. Leland, of the University of Minnesota.

The papers and discussions were largely upon pedagogical aspects of engineering education, with interest centering upon a paper by Prof. Wm. H. Burr, formerly Professor of Civil Engineering at Columbia University. Prof. Burr stated that enginering would not take its place with the legal and medical professions until it likewise was founded on a preliminary education in the liberal arts, suggesting that the engineering student should pursue a six-year course, three of liberal arts and three of engineering. Considerable disparagement of the work of the society was also voiced by Prof. Burr, who said in his paper that while the society had a great opportunity to raise engineering education to a higher plane, it confined its attention on details, overlooking fundamentals.

PERSONAL MENTION

Offie Leonard has resigned as office engineer of Travis County, Texas.

W. J. King has resigned as county engineer of Labette County, Kansas.

L. E. Laird has been appointed state highway superintendent of Wyoming.

L. C. McCanlies has resigned as county engineer of Callahan County, Texas.

Eugene E. Haskell has resigned as dean of engineering of Cornell University.

Harry N. Howe has been appointed commissioner of streets of Memphis, Tenn.

M. C. Hengst has been appointed highway engineer of Barry County, Michigan.

E. W. Davis, County Engineer of Gregg County, Texas, will also act as city engineer of Longview.

Dr. Phillip Woodworth has been appointed president of Rose Polytechnic Institute, Terre Haute, Ind.

W. C. Welborn has resigned as division engineer of the Texas State Highway Department to become city engineer of Paris, Tex.

C. E. Davies has been appointed editor of "Mechanical Engineering," the official journal of the American Society of Mechanical Engineers.

C. D. Buck has been appointed assistant state highway engineer of Delaware and will be in charge of road work in the state while C. M. Upham is acting as chief engineer for the North Carolina State Highway Commission.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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*Illustrated article

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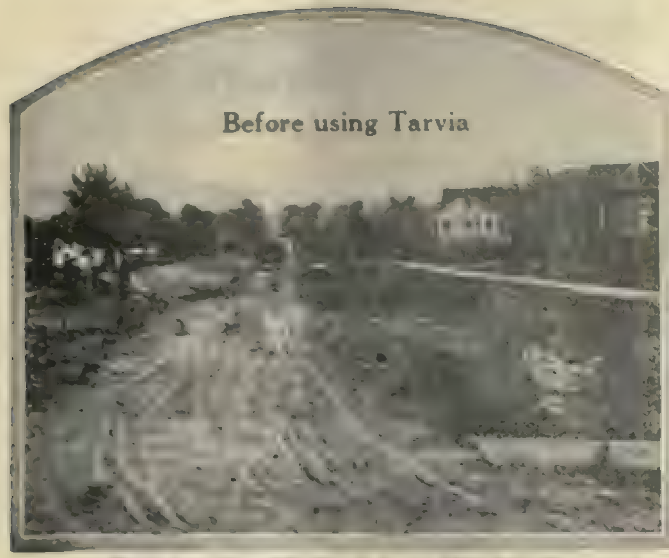
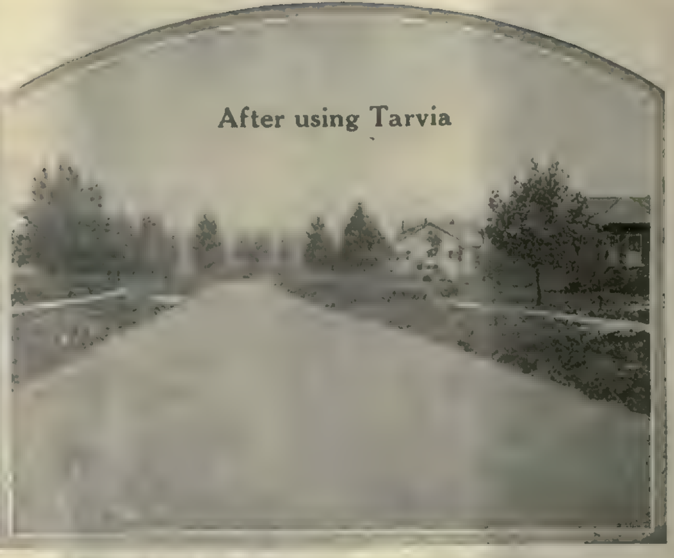


Wretched condition of Kenilworth Avenue, Villa Park, Ill., before the use of Tarvia



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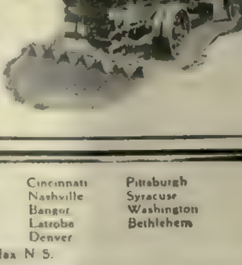

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GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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THE HIGHWAY CONTRACTOR AND ROAD BUILDER

Vol. LXI. NEW YORK, N. Y., JULY 20, 1921 Number 3

Bituminous Macadam and Bituminous Concrete Pavement Construction--I[*]

Distinction beween Bituminous Macadam and Bituminous Concrete—Requirements of the Bituminous Cement—Tests—Qualifications of the Coarse Aggregate—Methods of Laying Bituminous Macadam

By E. J. WULFF[†]

BITUMINOUS MACADAM AND BITUMINOUS CONCRETE PAVEMENTS are popular types of hard surfacing in almost all parts of the country. Though eminently successful when properly built, many of them have failed because of poor judgment in the selection of materials, unscientific methods of construction, incompetent supervision and inspection, and inferior workmanship—all causes that in no way reflect upon the pavement as a type. In this first installment, Mr. Wulff discusses the requirements of the materials used in bituminous pavements and the technic construction by the penetration method—the building of bituminous macadam roads. The installments to follow will treat of bituminous concrete construction.

It is customary to differentiate the types of bituminous pavement into two classes, namely, bituminous macadam and bituminous concrete. In the former the cold stone is coated, after being placed in the road, with heated bituminous material; in the latter the heated mineral aggregate composed of coarse and fine aggregate is mixed with heated bituminous material in a machine mixer and then placed on the road in a hot condition. The two materials that enter into the construction of the types of roads under consideration are bituminous materials and the mineral aggregate. These materials must be adapted for the various purposes, and most specifications describe the materials by certain requirements that they must have for the specific purpose intended.

The term "bituminous material" applies in common to asphalt as well as tar products. Both materials are used in penetration macadam; tars are employed only to a limited extent in bituminous concrete. When the term "asphaltic macadam" or "asphaltic concrete" is used the bituminous material is an asphalt.

The functions of the bituminous material in bituminous macadam and bituminous concrete are not quite analogous, although the adhesive quality of the bituminous material is the essential quality in both cases. In bituminous macadam the small stone and bituminous material serve as filler or binder, similar to the screenings and fine dust of a water-bound macadam. The interlocking action of the mineral aggregate is the main dependence against lateral displacement. As screenings and dust are omitted in bituminous macadam, these are replaced by stone chips and adhesive asphalt or tar, a combination which is not affected by water or excessive dryness nor by the sucking action of rubber tires.

In an asphaltic concrete the interlocking action of the stone is suplemented by a mortar formed of the fine mineral aggregate, which includes dust and an asphaltic cement. The function of this mortar is essentially analogous to that of the mortar in cement concrete.

Consistency the Important Quality of Bituminous Cement

On account of the different functions to be performed by the asphalt in the two different types, as well as the different working conditions under which it is employed when the pavement is laid, and the varying effect of climate, the consistency of the asphalt to be employed is important.

The suitable consistency differs materially for different types of pavements as well as for different climatic conditions. Thus for penetration macadam the consistency of the bituminous material must be such that when in a melted condition it is fluid enough under proper working conditions to flow freely and coat the coarse stone aggregate with a thin film. When cooled to summer temperatures it must be stiff enough not to flow. When still further cooled to winter conditions it must remain plastic enough to contract without cracking.

---

[*] From "Public Roads," the official publication of the U. S. Bureau of Public Roads, June, 1921.

[†] Senior Highway Engineer, U. S. Bureau of Public Roads.

The range of summer and winter temperatures differs materially for the United States. While high and prolonged summer temperatures may be expected throughout the country, the winter conditions are dissimilar. In the North, prolonged periods may occur when the temperature is at and below zero. In the Southern States, the winter temperature may but rarely reach the freezing point and then for short periods only. It is apparent that these extreme cases, as well as the variety of intermediate conditions, require bituminous materials of appropriate consistencies for local requirements.

The same principle applies as well to asphaltic concrete. In the latter the asphalt bodies, while distributed more uniformly through the fine mineral aggregate, are exceedingly small, and contraction is distributed on a large number of small bodies instead of concentrated on a few but large bodies. That alone would be a sufficient reason to employ a stiffer asphalt; however, other reasons and circumstances prompt the use of a stiffer asphalt. The principal reason is the function of the asphalt as a cement in uniting the mineral aggregate into a dense, stone-like mass. In addition there is the circumstance that the mineral aggregate is heated to substantially the same temperature as the asphalt before the materials are mixed, and this justifies the use of a stiffer asphalt. As the asphalt is exceedingly fluid at the proper working temperatures, it is possible to coat the mineral aggregate with a very thin film of asphalt instead of the comparatively heavy one which results in penetration macadam.

The bituminous materials used in penetration macadam are fluxed native asphalts, oil-asphalts (derived from the asphaltic-base oils), and tar products.

The suitability of a bituminous material for penetration work is measured by the test requirement for penetration in asphalts and the float test for tar products. Both tests determine the consistency of the bituminous material. For the northern section of the country, where very low temperatures may prevail for prolonged periods, as asphalt of a penetration of from 120 to 150 is ordinarily employed. That means, while the asphalt is not unreasonably soft during summer conditions, it retains a certain amount of plasticity during extremely cold weather. Furthermore, on account of its pliability it will reunite again when warm weather comes if there has been any separation of the asphalt bodies during the winter months.

Where extremely low temperatures do not occur or are of comparatively short duration the penetration requirement is placed at 90 to 120, and in the southern part of the United States, where freezing occurs but rarely, the penetration is from 80 to 90.

The corresponding float test requirements for tar products are as follows:

	Seconds.
For the northern section	90 to 120
For the middle belt	120 to 150
For the southern section	150 to 180

These test requirements should not be arbitrarily followed. The present tendency in the northern section is to select a somewhat stiffer material than that which is provided by the penetration test of 120 to 150 for asphalt or a corresponding float test of 90 to 120 seconds for tar products. The weight and amount of traffic should be one of the determining factors to be considered in selecting an appropriate consistency. Heavy and continuous traffic will prompt the use of a stiffer material than light traffic.

In specifications for the construction of penetration macadam, asphalts and tars are usually placed on an equal footing and the selection of the appropriate material is determined by local conditions. With the exception of one-size-stone bituminous concrete, where a tar product is occasionally employed the bituminous material for the concretes is usually as asphalt.

Quality of Stone Also Important Factor

Of equal importance with the asphalt is the quality and size of the stone aggregate from the viewpoint of service as well as workability when crushed. The adaptability of a rock is usually measured by its hardness and toughness, the latter quality being of greater importance than hardness alone. A very hard stone may also be friable under impact and may shatter under rolling or the subsequent impact of triffic much more easily than a softer stone of relatively greater toughness. The particular quality desired is frequently expressed by a test standard based upon the French coefficient of wear in which is expressed the results of a test which combines both hardness and toughness tests.

In a general way, it may be stated that a rock composed of small crystals is better adapted for use than a rock composed of comparatively large crystals. The trap rocks and other related volcanic rocks are composed of comparatively small crystals. A number or granites and metamorphic gneisses derived from granites are usually not so well adapted on account of their large crystals. Where a choice of materials is to be had, economically, the best material should be employed.

However, there are large sections of the United States where the best rock material is unobtainable economically and where rock material of an inferior quality must be used. The rocks mentioned above show more specifically the desirable and undesirable structural features to be noted by a merely visual observation.

Penetration Macadam

In the construction of bituminous macadam roads the lower limits of the French coefficient are usually placed at 7 or 8. This requirement includes all the trap rocks and many granites, gneisses, sandstones, and quartzites. Limestones of various origins range from extremely high to extremely low. Where a rock with the minimum French coefficient of 7 is unobtainable, as happens in many of our states, the lower limit is sometimes placed as low as 4.5. Where such a stone between 4.5 and 7 must of necessity be employed, it is advisable to use a coarser stone aggregate than where a harder stone is employed.

Next in importance to the suitability of the rock, as such, is the size of the stone fragments. The latter must be large enough so that the voids contained in the stone bed after compaction are still large enough to permit the penetration of the bituminous material and the coating of the stone. The same principle is also carried out in the stone chips which take the place of screenings as used in water-bound macadam. The stone chips must be free from dust.

The effect of using an excessively friable rock for the stone aggregate manifests itself in the further crushing of the stone under rolling with a heavy roller and the consequent closing of the necessary passages. Hence the requirement to use a larger sized coarse aggregate where a soft stone is the only kind available is needed to mitigate somewhat the effect of the further crushing under the rolling.

As the chief reliance is placed upon the interlocking action of the stone to obtain stability, rolling must be done until full compression has been obtained and all lateral movement has ceased before the bituminous binder is applied.

The importance of adequate rolling can not be emphasized too much, as a large number of failures —or at least, very undesirable features in the finished pavement—can be assigned only to insufficient rolling before applying the binder. Unless the coarse stone is rigidly keyed together to prevent lateral displacement the following application of bituminous material will have the effect of surrounding the stone with a lubricant which, under summer conditions and under traffic, favors the readjustment and constant displacement of the stone aggregate. This will produce ruts and other depressions and corresponding ridges over large parts of the road surface, which will not only make travel unpleasant but will also be destructive to vehicles. The condition of such a pavement becomes worse and worse in time as vehicular impact increases and the depressions increase in depth and the ridges in height.

AN ASPHALTIC MACADAM PAVEMENT—LAKE FOREST, ILL.

After the first application of the bituminous binder stone chips are spread, and these stone chips when rolled tend still further to key the coarse stones together and prevent lateral displacement.

After rolling this course, and after sweeping off all unabsorbed stone fragments, a further application of bituminous material is made in an amount just sufficient to provide a thin coating of the tar or asphalt, which is immediately covered with stone

(Continued on page 36)

Good Roads and Motor Buses to Solve the Rural School Problem[*]

Needed Consolidation of Rural Schools Only About 25% Completed—Further Progress Largely Dependent upon Motor Transportation and, Therefore, upon Highway Improvement—Economics of Rural School Consolidation—Vehicle Types

Your Committee on "Motor Bus Service for Consolidated Rural Schools" herewith respectfully submits the following progress report.

This report will be confined to brief discussions of recent progress in rural school consolidation, the use of the motor bus for the transportation of pupils and the development in equipment, and a somewhat more elaborate discussion of the relation between school consolidation and motor transportation of pupils. Subjects of local importance or which must be worked out as individual problems for each installation, such as operation details, will not be touched on, since time is limited and they require a lengthy discussion, if any. Also for the same reason, the relation between consolidation and transportation will be developed to apply only to those districts in which conditions are unfavorable to consolidation.

> *"GOOD ROADS MEAN GOOD SCHOOLS" was a popular slogan when the good roads movement was young and the motor truck and the motor bus were unknown.*
>
> *IN THE OLD DAYS A GOOD ROAD TO THE SCHOOLHOUSE meant only a roadway that the family buggy could traverse without miring. Distance was measured by time and the slow travel of the period limited the effective radius of influence of the country school to a few miles.*
>
> *DISTANCE IS STILL MEASURED BY TIME, but the motor-driven vehicle has quadrupled the area that can be served, so making possible the concentration of educational facilities.*
>
> *GREAT PROGRESS HAS BEEN MADE in consolidating the small "district schools" into modern, well equipped graded and high schools comparing very favorably with those in the cities. But much still remains to be done. This report comprises a brief, but comprehensive, survey of conditions, with especial reference to the part taken and to be taken by the motor vehicle and improved roads.*

At the beginning of 1920 there were about 13,000 consolidated schools in the country and 212,000 one-room schools, which should provide a field for about 40,000 more consolidations. Exact figures are not avaliable, but it is believed that 14,000 is a conservative estimate of the consolidated schools now in operation and that there are 3,000 to 4,000 more in prospect. Pennsylvania alone is working on 200 consolidation projects.

Educators are becoming more intensely interested in consolidation. It means a raise in the standard of teacher personnel and pay, a subject that is being agitated throughout the country. Many institutions of higher education, such as the Kentucky State University, and the Kansas State Agricultural College, are including the subject of consolidated schools in their extension courses. Women's clubs are interesting themselves in consolidation campaigns. The United States Department of the Interior is assisting in the consolidation movement and has the co-operation of the Department of Agriculture through its county agricultural agents.

So much for the progress of consolidation. What is of more interest at this time is the question of transportation. The following quotation is from a letter received from Mr. Lee L. Driver, Director, Bureau of Rural Education, Pennsylvania Department of Public Instruction.

"Hundreds and thousands of places are finding that the motor can be run, where it used to be thought impossible. They are also finding that it is cheaper when service is considered. Many communities have not purchased horse-drawn vehicle for two or three years and are relying wholly upon the motor. In Pennsylvania more motors are being used than horse-drawn vehicles."

One county superintendent in Ohio reports that last year they had 20 automobile buses and this year they have 60 and probably will be completely motorized within a short time. Cuyahoga County, Ohio, reports that no more horse-drawn vehicles will be purchased. Montezuma County, Kansas, expects to be completely consolidated this year, with six schools, using 50 buses, serving the whole county. The State of Washington, in the Northwest, reports that motor buses are the principal transportation medium and the State of North Carolina, in the Southwest, reports that motor buses are displacing horse-drawn vehicles.

It will be seen that the motor bus is rapidly becoming the recognized standard transportation medium where consolidation is in effect. Transportation is the most vital factor in rural school consolidation and, where consolidation is not in effect, the principal stumbling block in the path of its attainment is the question of transportation. It is for this reason that this report is largely devoted to a discussion of the importance of transportation to consolidation.

---

[*] Report of the National Committee on Motor Bus Service for Consolidated Rural Schools, presented at the annual convention of the National Highway Traffic Association, Detroit, Mich., April 29, 1921.

Presented by Ernest Farr, Chief of the Firestone Ship by Truck Bureau, Chairman.

As a foundation for a case for the motor bus it may be well to show just how dependent consolidation is on transportation. The two are so closely allied that it is impossible to discuss them separately. To support a consolidated school, the district must be large enough to furnish an adequate tax duplicate. When an area of that extent is included transportation must be provided, or a large percentage of the children in the district cannot attend, and it is not to be expected that a parent will vote to tax himself to maintain a school not available to his children. Without going into details, a compilation of several recent articles on consolidation gives 56 different advantages the consolidated school has over the old rural school. Of these 56 advantages, 14 are the direct result of furnishing transportation. The balance are dependent on transportation at least to the same extent as is consolidation, which is close to 100%.

The transportation of school children should be measured by time rather than distance. If a pupil be required to ride over one hour each way the undue fatigue probably will reduce his general efficiency, not to mention the fact that he may not have sufficient time left for the necessary duties on the farm. A comparison of horse and motor bus transportation on this time basis is interesting. It may be estimated conservatively that 6 mi., including necessary stops, is the maximum distance for a horse-drawn vehicle in one hour and that under similar conditions the motors bus will make 12 mi. In other words, the use of motor buses will quadruple the size of a district which may be served by a consolidated school, at the same time transporting the pupils in an equal length of time as well as in equal or greater comfort than in horse-drawn vehicles.

Returning briefly to the 56 advantages previously mentioned, 21 are directly dependent on the increased size and equipment of the school and 12 on the increase in number of pupils. Therefore, by multiplying the possible area by four, the motor bus not only enhances the efficiency of the majority of consolidated schools, but enables their establishment in districts where the area practical for horse-drawn vehicles cannot produce the necessary taxes to support the school and pupils to patronize it.

As an example, take the State of North Dakota. It may be assumed that a maximum travel distance of 6 mi. is a maximum air line distance of 3 mi. from the school, since as a rule the roads follow section lines and more or less doubling along the routes is necessary. This makes the maximum area of a consolidated district a circle of 3 mi. radius or about 28.25 sq. mi. Now the average assessed value of land in North Dakota is $3,750 per square mile or $106,000 in a district of 28.25 sq. mi. This means one of two things if horse-drawn vehicles must be relied upon—an open country consolidation which does not have the tax duplicate of a town or city to support it and cannot exist except as as incompletely equipped plant, little superior to the one-room school, or the district must be extended so that many of the pupils spend three to five hours a day traveling to and from school.

Other considerations are density of population and topography. On the average, in North Dakota, there would be only about 62 school children in a district of 28.25 sq. mi. of area. In the valleys of the eastern mountains and the canyons of the western, topography frequently makes consolidation impossible unless motor buses are used. Consequently it would seem that consolidation is absolutely dependent on motor bus transportation where average land value is low, where population is scattered or where topography necessitates a long, narrow district.

Enlarging a district increases the average transportation distance per child per day, so it may be well to compare in a general way the cost of motor bus and horse transportation. A compilation of the records of various schools representing all sections of the country shows an average transportation cost of 1.8 ct. per child-mile by motor bus and 3 ct. by horse hack. Still assuming that the bus is capable of double the time mileage possible by horse, and assuming districts of a maximum size of one transportation hour, the cost of transporting the average pupil will be 20% greater by bus than by horse hack. Transportation cost amounts to about 10 to 15% of the total cost of tuition. Therefore, under the most unfavorable circumstances the use of motor buses will increase the unit cost of tuition about 3%, but at the same time it offers the compensating advantage of a district of quadrupled area, greatly increasing the possibilities of economies in other directions. For instance, doubling the investment in the school plant should be more than sufficient to give equal advantages to four times the pupils, thus reducing the amount of taxes necessary to retire bonds by 50%.

Taking up the subject of bus equipment: Many improvements have been made during 1920. Several manufacturers of trucks and bodies have given the school bus special attention, with the result that there are now on the market several standardized buses providing maximum value, seating capacity and comfort at minimum cost. While it is important that each installation be studied as a separate problem, the general tendencies in chassis and body construction should be noted.

Where replacement equipment is being purchased, the tendency is to get away from the light chassis and use those of larger capacity, the 1 to 1½-ton being the most popular. This is an important and an apparently well founded development from the standpoint of safety as well as economy.

(Concluded on page 36)

Logical Plan of Federal Aid Work in Nebraska

State Divided into Construction Districts to Secure Comprehensive System Instead of "Patchwork" Roads—Lines and Grades Established and Grading and Draining Completed before Surfacing is Undertaken

PATCHWORK COLLECTIONS OF ROADS caused much dissatisfaction with early state aid work. Ten years ago the public prints were full of criticisms of road builders because, it was charged, they built roads that "began nowhere and ended nowhere."

HISTORY REPEATED ITSELF when federal aid became a factor in road improvement. One of the chief objections raised against the betterments effected by the aid of the Government has been that work is done here and there, with no apparent attempt to secure connected systems.

NEBRASKA SOLVED THE PROBLEM by dividing the state into "construction districts." The details of the plan and a brief sketch of its operation are given in this article.

Previous to the enactment of the Federal Aid Act in 1916, road work in Nebraska was done by the individual counties. After the passage of that law, however, the Legislature passed the bills necessary to secure to the state the benefits of federal aid and work was commenced upon a state highway system. An historical sketch of the development of federal aid work and a description of the work so far accomplished are presented in an article printed in a recent issue of the "Monthly Report," the official publication of the State Department of Public Works. The data in the following paragraphs are from that article and from information subsequently furnished by the department.

Under county control there were established so-called county road systems which, in reality, were not systems but collections of main roads upon which most of the county funds were spent. As a rule, it was possible to get from one town to another in the same county by following these roads, but the counties seldom cooperated to connect up their highways. The early work was poorly done and there was no maintenance, but this faulty policy was the result of inadequate funds rather than any lack of good intent on the part of the authorities.

Nebraska's share of the first federal aid appropriation was $1,600,000. The 1917 Legislature accepted all of the provisions of the federal act, appropriated $640,000 for federal aid work in the years of 1917 and 1918, and directed the state engineer to lay out a system of state highways.

Before the adjournment of the 1919 Legislature, Congress made an additional federal aid appropriation of $200,000,000, bringing Nebraska's share to $5,866,761.66. The Legislature then made an appropriation for 1919 and 1920 of $3,093,264, which made a total of $3,733,264 appropriated by the state and left a balance of something over $2,000,000 to be provided by the Legislature of 1921. The amount actually appropriated this year was $2,993,452.81, making a total by the state of $6,726,716.81, as against federal funds amounting to $5,866,761.66. The difference, $859,955.15 is for the use of the department for administration.

Pursuant to the direction of the 1917 Legislature, the state engineer conferred with the county boards and with commercial clubs and presented to the 1919 Legislature a layout of a comprehensive system of state highways. That body finally approved the system and established it by statute. The system includes 4,500 mi. of roads so located as to connect all county seats and all important towns.

In order to facilitate the work the state was divided into construction districts, each of five counties.

"The district," according to the article to which reference has been made, "was considered as a unit in preparing plans for construction, rather than a county. In this way a project could be constructed in each district, the estimated cost of which might exceed a county's allotment, but which would not exceed the district allotment. When later appropriations by the state were made, each county would eventually get the entire amount of its allotment. The reason for this action was that for the first year or two the available funds for each county, if taken separately, would not be sufficient to build a project of desirable length. Short stretches might have been built, but this would have provided disconnected stretches of improved roads. Thus, it would have been necessary to postpone construction until additional funds became available in such counties, and this, in turn, would have resulted in so large an amount of construction work during the final years of the appropriations that it would be extremely difficult, if not impossible, to handle."

In order to secure efficient administration, the state was divided into five divisions, each in charge of a division engineer. This year two additional divisions were established. The division engineers are the agents of the Department of Public Works and are in direct charge of all work in their respective divisions.

Surveying was commenced in 1917 and construction in 1918. The cost of preliminary surveys and plans ranged from $75 to $100 per mile.

(Concluded on page 37)

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

Founded January, 1892

E. L. POWERS
Editor

T. A. HULBERT
Managing Editor

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Copy for advertisements must reach the New York office by noon on Tuesday of the week before date of issue if proofs are to be submitted.

Copy for classified and other advertisements where proofs are not required will be accepted until noon on Monday of the week of issue.

Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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Vol. LXI July 20, 1921 No. 3

"BITUMINOUS MACADAM" AND "BITUMINOUS CONCRETE."

Bituminous macadam and bituminous concrete pavements are discussed at some length and in considerable detail by one of the engineers of the U. S. Bureau of Public Roads in an article of which the first installment appears on other pages of this issue.

One of the points made early in the article is the difference between these two types—a matter that ought to be emphasized for the benefit of the general public.

The average road user classes all bituminous pavements—concrete and macadam, surface treated roads of all kinds, asphaltic and tarred—as "asphalt" or, less frequently, as "tar" roads. There is little difference in the appearance of bituminous pavements; to the layman none. Under the circumstances a motorist can not be blamed for his lack of knowledge, especially since the newspapers and magazines he reads are notoriously lax in what they print about roads and road work.

Engineers are partly responsible for these conditions, and they are also in excellent positions to remedy them. Local papers, especially in the smaller cities and towns, generally look to the engineers in their communities for the news in the road building field. When asked for information, the engineer should take pains to explain carefully what he says, bearing in mind that he is talking to a layman to whom some of the terms that are entirely familiar to the engineer mean little or nothing. He should also take care to correct any misstatements that appear.

Reporters and editors want accuracy and truth, but they are often too busy to dig it out of the mass of half-information and misinformation that is handed to them. The road building fraternity can—and should—help get accurate information to the public.

All engineers need better contact with the lay public. Closer relations are especially needed by those engineers who, like road builders, occupy public offices. The public prints are the best mediums for establishing and maintaining that contact.

GOOD ROADS AND GOOD SCHOOLS

In the early days of the good roads movement, before the motor-driven vehicle had found practical application in the nation's business and real highway systems were only the dreams of a few earnest men of vision, one of the chief arguments of the good roads advocate was that good roads would bring good schools.

Those who used the argument most little realized the strength of their argument—little foresaw the extent to which their prophecy would be fulfilled.

Elsewhere in this issue is the report of a committee of the National Highway Traffic Association on motor bus service for consolidated rural schools. According to the committee's figures, at the beginning of 1920 there were 13,000 consolidated rural schools in the country. There were also 212,000 one-room schools in the rural districts, and these, in the opinion of the committee, "should provide a field for about 40,000 more consolidations." Assuming that the figures are accurate, the work of consolidating the scattered "district schools" of the country into modern graded schools and up-to-date high schools is only about 25% completed.

This consolidation has been made possible largely by the improvement of rural highways to a degree that permits the use of motor-driven vehicles. Without the motor bus, good roads would have made possible a great deal of concentration of educational facilities, for the efficiency of horse-drawn equipment would have been greatly increased. But dependence upon such transportation facilities would have limited the area possible to include in a district served by a consolidated school to one of a radius small enough to permit the use of horse-drawn equipment without too great loss of time. The motor bus, according to the report, has doubled this radius, thus quadrupling the area served. As a matter of fact, the area is often increased much more than that.

The education of the children in rural communities is a matter of vital significance to the future of America. Besides the obvious reasons for providing every possible facility for education, there is the added reason in the case of the children of the farms, of making farm life more attractive and so aiding in the solution of another vital American problem—increasing the food production. Any means for bettering rural school conditions and living conditions on the farms deserves all the encouragement that can be given to it. Motor transportation is a powerful agency for the accomplishment of both of these objects. And if motor transportation is to attain its maximum development, good roads must be built and maintained throughout the country.

Virginia to Let Contracts to Limit of Available Funds

The State of Virginia will have let contracts by the end of July to cover all available funds for this year, according to G. P. Coleman, State Highway Commissioner. For next year the only funds now certain to be available will total about $2,600,000, including convict labor valued at $300,000.

Bituminous Macadam and Bituminous Concrete Pavement Construction

(Continued from page 31)

chips and rolled. It is of the utmost importance that the stone should be reasonably clean and free from dust in order that the stone, whether large or small, may be properly coated with the binder. Dust, if in the form of a permanent coating on the stone, will prevent the adhesion of binder to the stone; if present as part of the stone due to crushing under the rolling or as bodies of fine material present in the coarse aggregate, it will prevent the uniform penetration of the binder. Such conditions if permitted will in time develop patches of unabsorbed bituminous material on the surface. An excessive amount of tar or asphalt in the seal coat has the effect of forming a mat of stone chips and bituminous material which, being more or less pliable, develops alternate ridges and depressions at short intervals, giving the road surface a corrugated appearance. It frequently happens that the stone is placed some time in advance of the spreading of the bituminous binder and the stone becomes covered with fine roadside dust. The latter condition prevents the adhesion of the bituminous binder and only a liberal flushing with water will restore a condition that will permit the adhesion of the binder to the stone. This flushing should be done some time in advance of the spreading of the binder. A careful inspection of the stone bed is necessary to detect and remove pockets of fine stone or excessively crushed material and replace them with new stone properly compacted. Good workmanship and care in the various processes while simple is absolutely essential to obtain satisfactory results. While it is possible to spread the bituminous material by hand from pots it has become customary to make the application by means of specially constructed distributing wagons. The latter are tanks, mounted usually on motor trucks, and the distribution of the hot liquid is effected in a thin sheet under a constant air pressure. The latter insures a uniform application in a predetermined amount.

Good Roads and Motor Buses to Solve the Rural School Problem

(Concluded from page 33)

Bodies may be divided roughly into two classes—the side-seater and the cross-seater. The side-seater gives a minimum of comfort and seating capacity. A recent development of the side-seater has an extra seat down the center, accommodating three rows of pupils lengthwise in the bus. This gives added seating capacity, but is not all that could be desired so far as comfort is concerned and is rather unsafe unless a rear door is provided which, in turn, reduces the capacity. The cross-seater is of two general types, one having individual side entrances and the other having an isle down the center, and rear and front doors. Considering seating capacity, comfort and safety in their relative importance, it is believed that the last mentioned type is the best for the average installation.

The dependence of consolidated schools on motor transportation has been emphasized. In conclusion it should be stated that the motor bus is also dependent on, and greatly limited by, a very important factor. From all over the country come reports substantially the same as that contained in a recent communication from J. C. Muerman, Specialist in Rural Education, Department of the Interior. Mr. Muerman says:

"Until we have a better system of roads and more money for roads, I do not look to see the consolidated schools advance as rapidly as they will when the good roads problem is settled."

Will Dedicate Peace Portal on Pacific Highway

The Pacific Highway Association will dedicate its peace portal near Blaine, Wash., on Sept. 6, in commemoration of the century of peace between the United States and Great Britian. This portal is built of stone and will contain on the Canadian side a piece of the "Beaver" the first steamship to enter the Pacific Ocean, and on the American side a piece of the "Mayflower."

The Pacific Highway is about 2,000 mi. long, extending from the Canadian border to the Mexican border.

Philadelphia Builds Boulevard Section of Lincoln Highway

The Bureau of Highways of Philadelphia, Pa., will complete this season a 4-mi. section of the Lincoln Highway known as "Bensalem Branch of the Roosevelt Boulevard." The new construction will extend the boulevard to the county line to Route 281 of the state highway system, a part of the Lincoln Highway.

Roosevelt Boulevard between Rhawn and Broad Sts. has a center driveway 60 ft. wide and two side drives 30 ft. wide. The center drive is used by passenger automobiles only, and the side drives by passenger automobiles and motor trucks.

An ornamental concrete, stone-faced arch bridge of 40 ft. span and 80 ft. wide will be constructed over Poquessing Creek.

Logical Plan of Federal Aid Work in Nebraska

(Concluded from page 34)

The early contracts awarded to counties were carried out with considerable delay and interruption. Attempts were made to use men and teams when they were not employed on the farms, with the result that the progress of the work was dependent upon the whims of the farmers. Several such contracts, awarded in 1918, had not been completed at the opening of the present season, though the amount of work involved was not more than a capable contractor could do in a season.

In 1918 and 1919 the average cost of earthwork was about 35 ct. per cubic yard. In 1920 it was about 58 ct. In other states last year, according to figures obtained from answers to a questionnaire sent out by the Nebraska officials, the cost ranged from 60 ct. in South Dakota to 94 ct. in Indiana, the states reporting being Kansas, Missouri, Iowa, Colorado, Utah, Nevada, Michigan, Illinois, South Dakota, Ohio and Indiana. This cost is commented upon in the article as follows:

"It is of interest to compare our average bid price of 58 ct. with the average bid price of 75 ct. in other states. This meant a saving to the state of 17 ct. per cubic yard and, on the 7,000,000 cu. yd. contracted for, made a saving of $1,190,000. This was made possible only through careful planning. Early in the spring of 1920 we announced the work which was to be let. At the letting the contractors were very well represented. We had provided that the bids for the contracts which were to be awarded each day were to be filed on the morning of the same day. On opening the bids, the first day, we found the average bid price to be about 65 ct. per cubic yard. The bids were promptly rejected and the state took the contract at the estimated price, which was 50 ct. On the second day the average bid was 58 ct., a saving of 7 ct. on the yard."

A large part of the state highway system is level and on that portion grading was done with 12-ft. blade graders hauled by tractors. On the average road one of these outfits completed about 1 mi. per 10-hour day. To Dec. 1, 1920, these heavy gang crews finished 1,500 mi. at a cost of something less than $200 per mile, the cost being met from motor vehicle taxes.

A saving of $216,055.75 over prices bid by contractors was made on work contracted for by the department. In addition to this there was an indirect saving due to the rejection of bids at the letting to which reference has been made of $47,451.06. On clay and gravel surfacing work done by the department a saving of $144,868.78 over bid prices was effected, making a total saving of $408,375.59.

Up to April of this year the department had awarded contracts for over $7,000,000 worth of work, covering about 1,200 mi. of state highway system. In May contracts were awarded for additional work amounting to $1,642,967.02 and covering 369.15 mi. There will be another letting this month.

"The entire letting was for earth excavation," Secretary George E. Johnson of the Department of Public Works reports, "as we have followed the policy in this state of perfectly grading, straightening and draining the state highway system first and, therefore, preparing the way for hard surfacing later. There are a few exceptions, where gravel and surfacing of sand-clay are used."

◆

Five Bridges in Adams County, Pennsylvania, have been declared unsafe for traffic.

The State of New Jersey on June 29 sold $3,300,000 of a total of $5,000,000 bridge and tunnel bonds offered.

Norfolk, Va., will widen Bank Street between Main Street and Princess Anne Avenue to 60 ft., at a cost of $194,000.

The Maryland State Roads Commission has 112 convicts at work on roads at the present time, paying 18 ct. an hour and meals for this labor.

A Bill Permitting Missouri to acquire cement mills has been introduced in the State Legislature. The bill carries an appropriation of $2,000,000.

A Temporary Bridge at Bordentown, N. J., collapsed recently, killing one workman and seriously injuring another. A new bridge over Black Creek on the Trenton-Camden Road is being built and the old bridge was moved downstream as a temporary structure. A truck passed over the bridge just before it fell.

Texas Has Big Road Program

Approximately 2,300 mi. of highways are under construction in Texas, involving a total cost of nearly $27,000,000. This mileage is embraced in 192 state and federal aid projects. Plans have been approved for 82 projects, involving 900 mi. additional at a total cost of $12,640,000 and 10 more projects at a total of $1,330,000 are pending.

City Magistrates May Revoke Motor Licenses in New York State

Under a new law which went into effect on July 1, city magistrates of New York State are empowered to revoke the licenses of motor vehicle operators. The magistrate must immediately forward a certificate to the Automobile Bureau of the new State Tax Commission, which, after a hearing, can reissue the license.

Trucks Transport Much Live Stock

Testifying before the Interstate Commerce Commission at a hearing on freight rates on live stock, A. F. Stryker, Secretary of the Omaha Live Stock Exchange, stated:

"The high freight rates are forcing live stock producers to ship by truck. In one day's receipts at Omaha, 20% of the hogs were delivered by truck. On Monday, June 6, 50% of the sheep received at the St. Joseph market came by truck."

It is estimated that 3,000,000 head of cattle, hogs and sheep will be transported by motor truck direct from the farm to the yards during 1921, this being based on 1920 figures from 17 stockyards in the corn belt.

Most Accidents on Straight Roads

Motorists "Hits Her Up" on Tangents And Uses Caution on Curves

More accidents occur on straight highways in Maryland than at curves or cross roads, according to Harry D. Williar, Assistant Chief Engineer of the Maryland State Roads Commission. During the past two months Mr. Williar has kept a record of highway accidents in the state, maintaining a map upon which tacks are placed to indicate accidents.

"To prove that what I contend is true," said Mr. Williar, pointing to the map, "just take a look at this map. The Baltimore-Frederick Road is the straightest highway in the state and perhaps the most used. Look at the number of tacks which fill this road. There are 16 tacks on that road, indicating 16 accidents, and four of them were fatal. The majority of them were due to speeding, failing to give right of way, or improper driving. It seems to be the weakness of an automobilist to hit her up when he gets on a straight stretch of roadway. On roads where there are curves, there is an inclination to be a little more careful."

The month of June showed a decrease in accidents on Maryland roads, there being 30, as compared with 37 in May. Six persons were killed and 13 injured in June and 8 killed and 20 injured in May. Mr. Williar classifies the causes of the June accidents as follows: Faulty driving, 15; violation of law, 7; trouble with machine, 5; wet roads, 3. The six fatalities were due to: Failing to heed warning at railroad crossing, 2; speeding, 1; wrong side of road, 1; trying to pass a truck with speed, 1.

Road News on the Sporting Page and "Wagon Roads"

Two years ago last January a gentleman interested in highway development walked into a western newspaper office and asked for the editor.

"I understand," said the visitor, on being introduced to the boss molder of public opinion, "that you publish an annual review of each year's progress."

"We do."

"All right. I'd like to write your road review."

"We'd be delighted, no doubt, but you'll have to see the sporting editor. Roads are his department."

"Very well," the visitor replied, with a slight show of temper, "I'll do that, but will you tell me, if you can, about what time in the course of human events the roads will be taken out of the sporting column? What's the joke, anyway? Is it a gamble whether you get there or not? Or did the roads get into that column when human jackasses were trying to see who could ride to death the quickest, and you just left them there because you still think the automobile is a sporting device?"

The editor pushed up his eyeshade and grinned.

"I don't know; just left 'em there, I suppose. Anyway you'll have to see the sporting editor," he said, and turned on his heel.

Now comes another extreme—amusing at first thought—but hardly as far ahead of date as the western editor was out of date. What would you think, for instance, of a bill requiring the construction and maintenance of landing places along the public highways every 25 mi. for aeroplanes?

Nonsense? No. That very thing is provided for in the usual, dignified, law-making style in "H. R. 4398, A BILL etc."

And yet along with this measure—somewhat in advance of the period, perhaps—three other highway measures have been thrown into the legislative hopper, stating at some length that they are for the purpose of "constructing, repairing and maintaining **public wagon roads.**"

And this—in national legislative halls—as the sound of the wagon wheel dies away in the receding past.—*American Highway Educational Bureau.*

Strong Opposition to Oil Tariff

President Harding Favors Leaving Petroleum on Free List—American Automobile Association Urges Local Clubs to Protest to Congressmen

Determined opposition to the imposition of high duties on petroleum imports, as proposed in the Fordney tariff bill, is developing in official and unofficial quarters.

President Harding wrote last week to Mr. Fordney, urging the retention of petroleum on the free list in order to avoid inteference with the Administration's policy of encouraging the development of foreign resources by American capital. His letter was followed by a long argument in the House, many Republicans, as well as Democrats, differing with the President's views.

Secretary of Commerce Herbert Hoover is understood to be strongly opposed to the oil duties and is said to have discussed the matter with President Harding before the latter wrote the letter to the Ways and Means Committee.

The American Automobile Association has taken a definite stand in opposition to the proposed tax and has outlined its position in a memorandum recently sent out to automobile club secretaries.

The memorandum follows:

The Committee on Ways and Means of the House of Representatives recently included in the tariff bill reported to the House a schedule on crude oil amounting to 35 ct. per barrel. This amounts to about 100% ad valorem in addition to the export duty of 113% now imposed by the Mexican Government, the chief source of petroleum imported into this country.

Our consumption of petroleum products exceeds our domestic production by about 66,000,000 bbl. annually. Our imports of petroleum are valued at about $90,000,000 annually, yet our exports of refined petroleum products amount to about $549,000,000 annually.

If this tariff prevails, it will enable and encourage foreign countries to monopolize foreign supplies of petroleum. At present we are supplying the world with two-thirds of its petroleum products, notwithstanding the fact that we have only one-sixth of the world's resources.

Petroleum is one of our greatest natural resources. It is both definitely limited and rapidly diminishing. A tariff on oil, therefore, places a premium on the rapid depletion of this great natural resource.

The American people are the largest users of petroleum in the world. It is estimated that 83% of the motor vehicles of the entire earth are found in the United States. Yet less than 17% of the world's resources of petroleum is situated within the United States.

Sixty per cent. of all the asphaltic materials used in the United States for road building and roofing purposes are imported from Mexico. If this tariff on petroleum finally prevails, it would, therefore, seriously interfere with the present road building program of the country.

In view of these facts, the American Automobile Association, in annual convention assembled, in Washington, May 16 and 17, passed a resolution of protest against any provisions being included in the tariff measure on petroleum. The Executive Committee of the A. A. A., on Wednesday, July 6, voted in opposition to the 35 ct. tariff on crude oil and authorized notices to be sent to club secretaries urging them to ask their representatives in Congress to oppose this tariff.

A vote will be taken on this schedule about the 21st of this month. You and the members of your club are, therefore, urgently requested to communicate by letter, or by wire if necessary, with your representatives in the House, protesting against this schedule.

We will keep you in touch with what happens in the House and later on it may be desirable to communicate with your senators on this subject when the tariff bill reaches the Senate. Please supply us with copies of any replies you may receive from members of Congress on this subject.

Pittsburgh Bridge Destroyed by Fire

The Allegheny River Bridge at Pittsburg, Pa., was destroyed by fire on July 8. This bridge was purchased from private owners in 1911 by Alleghney County and was a steel truss structure with wooden floor. Two spans, one of which was 200 ft. long, collapsed shortly after the fire started.

Highway Bills Stalled in Committee

The Senate Committee on Post Offices and Post Roads, to which the Townsend Bill and the Phipps-Dowell Bill have been referred, has not yet taken any action on either of the measures, according to latest reports. Senator Townsend, Chairman of the committee, has absented himself from Washington, thus delaying any action on the bills.

Average Unit Prices at Recent Letting in Philadelphia

At a street letting in Philadelphia on July 15, low bids totaling $926,607 were received. The following average unit prices were compiled from the low bids.

Asphalt surface and binder, including 6-in. concrete base	$3.43
Vitrified block gutter paving, including 5-in. concrete base, cement-grit bed and cement grout filler	4.57
Crushed stone base, 5 in. including subgrading and preparation of subgrade surface	1.20
Bituminous macadam surface, 3 in.	1.20
Asphalt 1½-in. binder and 1-in. surface, including 6-in. concrete base	2.92
With 1½-in. surface course	2.97
Vitrified block gutter paving, including 5-in. concrete base, cement-grit bed and cement grout filler	3.88
Selected old granite block, including 6-in. concrete base, cement-sand bed and bituminous mastic joint filler	3.15
Smooth dressed granite block, including 6-in. concrete base, cement-sand bed and bituminous mastic joint filler	7.42
Removing and disposing of existing asphalt on bituminous base, including subgrading	0.55
Removing granite block on gravel base, including subgrading	0.57
Redressed granite block pavement, including 6-in. concrete base, cement-sand or cement-grit bed and cement grout filler	3.13
With bituminous mastic filler	3.73
Selected old granite block, including 6-in. concrete base, cement-sand or cement-grit bed and cement grout filler	2.63
With bituminous mastic filler	3.21
Removing existing granite block on gravel base, including subgrading	0.71
Removing existing granite block and bed courses from concrete base	0.20
Grading, excavation, per cu. yd.	0.60
Grading, fill, per cu. yd.	0.47

MEETINGS

Calendar of Coming Meetings

Aug. 30-Sept. 1—Michigan State Good Roads Association.—Annual meeting, Flint, Mich. P. T. Colgrove, Pres., Hastings, Mich.

Oct. 24-28—American Society for Municipal Improvements—Annual Convention, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

PERSONAL MENTION

Frank Jones has resigned as superintendent of highways of Duval County, Florida.

W. C. Spooner has been appointed superintendent of highways of Duval County, Florida.

W. J. McCluskey, Jr., has been appointed assistant division engineer by the West Virginia State Highway Department.

J. B. Pridgen has been appointed engineer in charge of construction by the North Carolina State Highway Commission.

Ellis G. Middleton has resigned as village engineer of Le Roy, N. Y., and is now with the West Virginia State Highway Department.

R. C. Limerich, formerly project engineer, has been appointed state highway engineer of Arkansas, succeesing V. P. Knott, resigned.

W. W. Stringfellow has been appointed a member of the Alabama State Highway Commission, succeeding Lloyd M. Hooper, resigned.

B. A. Briggs has resigned as superintendent of streets of Colorado Springs, Colo., and is now with the Colorado State Highway Department.

J. K. McGrath has resigned as county engineer of Fayette County, West Virginia, and is now division engineer with the West Virginia State Highway Department.

Herschel C. Smith, formerly Deputy State Highway Engineer of Oklahoma, has been appointed assistant professor of highway engineering and highway transport at the University of Michigan. Mr. Smith graduated from this institution in 1913 and in 1920 was elected Roy D. Chapin fellow, receiving last June the degree of M. Sc. in highway engineering and highway transport.

OBITUARY

S. T. Morse, City Engineer of Carlinville, Ill., was killed on June 3 in an automobile accident.

James Owen, for over 40 years engineer of Essex County, New Jersey, and for nearly 20 years town engineer of Montclair, N. J., died in Bayhead, N. J., on July 5 at the age of 76 years. Mr. Owen was born in England in 1845, coming to this country in 1864 with G. K. Radford, a civil engineer to whom Mr. Owen was apprenticed at the age of 15 years. In 1867 Mr. Owen was appointed assistant engineer with the Brooklyn Park Board, then engaged in laying out Prospect Park. In 1868 he was appointed engineer of the Essex County Public Road and later in the year made county engineer, which position he held until 1913.

◆

Rural Schools in the United States operate 12,000 motor vehicles.

Holland has 10,000 Motor Vehicles, or only one car to every 700 inhabitants.

Bennettsville, S. C. on June 8 voted a bond issue of $200,000 for street improvements, only two votes being cast against the proposition.

Madison County, Alabama, recently offered $200,000 of road bonds for sale and received bids ranging from 75 to 85. The bids were rejected.

The State of Kentucky is operating eight camps for convicts on road work, located at Pike, Harlan, Rockcastle, Barren, Cumberland, Owen, Henry and Bath.

Dougherty County, Alabama, plans to spend $400,000 on road work this season. A large bridge over the Flint River costing $300,000 is also being constructed with county and federal funds.

King County, Washington, has reduced the wages of road laborers from $4.50 to $4 per day, and men with teams from $9 to $8. About 200 men are now employed on road work in the county.

Resolutions Favoring the Dowell Bill have been passed by a number of organizations in Georgia, including the Board of Commissioners of Roads of Bibb County, the Board of Commissioners of Roads of Dodge County, The Board of Commissioners of Roads of Bartow County, the Board of Commissioners of Roads of Decatur County and the Gilmer County Good Roads Association.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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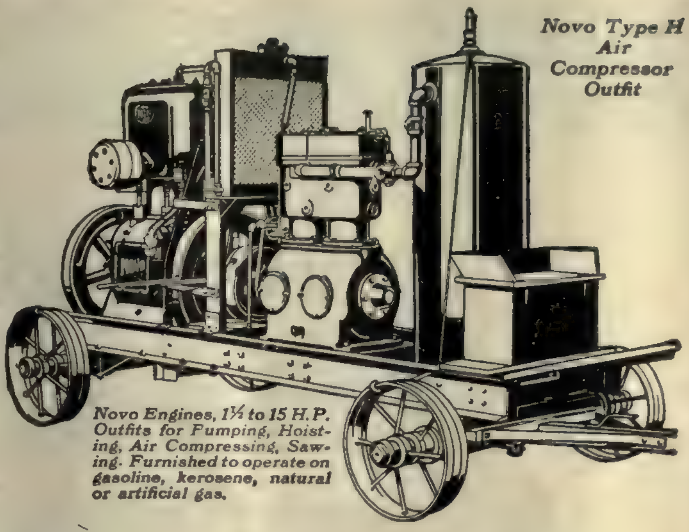

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Safety Zones and Parking Regulations*

Opinions of Traffic Officials on Safety Zones and the Practices in Regard to Them in Various American Cities—Restrictions on Parking Near Safety Zones—Suggested Uniform Laws Relating to Parking—The Detroit Method

Your Committee on "Relative Efficiency of Different Types of Car-Stop Safety Zones and Their Relations to Parking and Ranking Regulations" herewith respectfully submits the following progress report.

The success of elevated platforms for safety zones has been demonstrated in Detroit, where one located on Woodward Ave. at the intersection of Gratiot has accommodated approximately 10,000 car riders daily during the 1½ hours up to 6:00 p. m., for over a year without an accident. Many people use this safety zone rather than go to more convenient zones which are not elevated. This platform is 216 ft. long, 5 ft. 6 in. wide and 7½ in. high, made of planks, and will this spring be replaced with concrete. For the purpose of building elevated concrete safety zones the city appropriated $15,000.

Safe highways must be had. Making the roads and streets safe for ALL the users is one of the vital tasks confronting highway officials. It is a complex problem. One of its many phases is discussed in the committee report printed on this page.

> *Should safety zones be elevated above the street level?*
>
> *Should they be equipped with special lighting arrangements?*
>
> *How should they be marked?*
>
> *What parking regulations should obtain in their vicinity?*
>
> *How should these and other parking regulations be enforced?*

These are a few of the questions that must be answered before city streets can be made safe. The report tells what police officials think and what measures have been adopted in a number of representative American cities.

In addition to the elevated safety zone at Woodward and Gratiot, Detroit has two others, being at Woodward and the Seven Mile Road, and Gratiot Ave. at Riopelle St. The zone at Woodward and the Seven Mile Road is 84 ft. 10 in. long, 3 ft. 6 in. wide and 6 in. high. We received many complaints from car riders in this section who said their lives were jeopardized by motorists. The traffic there is growing tremendously and moves faster than in the downtown districts. This zone permits large interurban cars with trailers to handle passengers. It has given extreme satisfaction and the Woodward Avenue Improvement Association compliments the department.

The zone at Gratiot Ave. and Riopelle St. is 72 ft. 9 in. long, 6 ft. wide and 7½ in. high. At this location the streets run into Gratiot Ave. at such an angle that before this raised zone was established a dangerous condition existed. The traffic is very heavy at this point, it being a main trunk line near the Eastern Market where many thousands of vehicles and many people go every day. The installation of the zone has greatly relieved a dangerous traffic problem and has slowed down traffic and compelled drivers to make the proper turns in going in various directions from this location, and has been a great safeguard for people boarding and leaving street cars at this point.

In response to an inquiry which your committee sent to the chiefs of police of 15 American cities, the advisibility of using elevated safety zones to protect pedestrians in the streets from motor vehicles was discussed. Ten cities favor elevated safety zones; five are opposed to their use.

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*Report of the National Committee on Relative Efficiency of Different Types of Car Stop Safety Zones and Their Relation to Parking and Ranking Regulations, of the National Highway Traffic Association, presented at the annual convention, Detroit, Mich., April 29, 1921.

Presented by George A. Walters, Second Deputy Police Commissioner of Detroit, Chairman.

Those favoring it are Duluth, Los Angeles, Baltimore, Hartford, Pittsburgh, Cincinnati, Bridgeport, Minneapolis, Dayton and Washington. Those opposed are Buffalo, Rochester, Boston, Chicago and Cleveland.

The height favored ranges from 3 to12 in., the latter being the recommendation of Pittsburgh; Washington favors 9½ in. Widths from 3 to 6 ft. are recommended, Pittsburgh favoring 3 ft. and Washington 6 ft. Regarding the length, most of the cities think that two or three car lengths is about right.

On the question of whether or not the safety zones should be lighted by other means than the use of street lights, all of the cities answer an emphatic yes with the exception of Duluth and Buffalo which maintain that ordinary street light should be adequate to make special lighting unnecessary. Los Angeles says: "Special lights by all means," and Chief Quigley of Rochester says: "Street lights are not sufficient under any circumstances." But Chief Farrall of Hartford says: "In some places street lights might be sufficient." Pittsburgh says their elevated zones require lights at each end, and Minneapolis states that: "Street lights never are sufficient."

Regarding the use of safety zones for pedestrians at other points than where car riders use them, Duluth, Los Angeles, Rochester, Cincinnati and Minneapolis answer no. Eight of the cities favor them on wide streets where traffic is heavy. Pittsburgh has them at boulevard "Ys," and Washington at intersecting streets owing to the width of the crossing.

As to whether they should be used at crosswalks at or near the center of all wide streets where traffic is heavy, Duluth, Los Angeles and Rochester do not favor this, Chief Quigley of Rochester, remarking that he "prefers to have traffic move at right angles; no right or left hand turns." Boston suggests that they be placed near or in line with the crosswalks and Bridgeport recommends them at the center of all wide streets. Baltimore, Hartford, Pittsburgh, Cleveland, Dayton and Washington also favor them.

In reply to the inquiry regarding the advisibility of using "islands of safety" extensively elsewhere than at street car stops, Duluth, Los Angeles, Rochester, Boston, Chicago, Cincinnati and Minneapolis reply in the negative, Minneapolis remarking that roadways should be unobstructed. Baltimore, Pittsburgh, Bridgeport, Cleveland and Washington favor them on very wide streets, and Hartford states that they can be used to advantage at any point where traffic is heavy. Dayton recommends them at street crossings close to schools.

Duluth at present is using safety zone standards with ropes; Chief of Police Major Pugh, however, favors the use of inlaid safety zones with edges beveled to pavement level.

Los Angeles streets are too narrow to allow safety zones except at certain intersections. The city uses a standard with the words, "Keep to the Right," and uses white paint to outline the zone.

Baltimore recommends that the safety zone platform be either of concrete or wood with 1½-in. pipe standards connected one to the other with a chain.

Chief Quigley of Rochester remarks: "We are using at street intersections a standard which seems to answer the purpose. It is placed in the center of the square or intersecting streets. In the day time a red flag is placed upon it, and during the night time a red light, which serves as a warning to approaching vehicles to slow down and get vehicle under control. Our records show that at such points accidents have been reduced to a minimum. Placing these standards as above compels drivers of vehicles to keep close to the curb when entering the square or intersecting streets and to slow down when turning to the left. They also serve as a marker for the street center and pedestrians when crossing the street, standing on a line with them when vehicles are approaching, are protected from such vehicles as might, if they were not so placed, drive along the center of the streets."

Boston has no safety zones. Commissioner Curtis favors iron posts as being the best type of safety zone marker, if any is used.

Our inquiry was referred by the Chief of Police of Chicago to Capt. Lavin of their Traffic Division, who is not in favor of elevated safety zones or islands of safety. Capt. Lavin remarks that: "None are used in this city because it is believed that an obstruction of this kind placed in the middle of any crowded thoroughfare not only adds to congestion by narrowing the usable width of the street, but is very dangerous to the driving public; at least this is the experience of some of the park systems which are under state control. I assume the theory of islands and raised safety zones is that it affords safety to those who are able to cross through the real danger zone, namely from the curb to the center of the street, but it is hard to see how they afford any protection to those passing over the most dangerous part of the street."

Since receiving the foregoing from Capt. Lavin the Chicago Common Council has passed an ordinance requiring that safety zones be established and a representative of the City Finance Committee visited Detroit recently to investigate the different types of safety zones, including those that are elevated, with a view to their use in Chicago.

Washington advises that they have found it necessary to establish zones adjacent to circles at intersecting streets for the safety of pedestrians.

Inspector Jackson, commanding the Detroit Police Traffic Division, recommends the following:

1. The use of elevated safety zones wherever traffic conditions will permit.

(Concluded on page 46)

Bituminous Macadam and Bituminous Concrete Pavement Construction—II*

Development of the Asphaltic Concrete Type—Use of Coarse Aggregates no Longer Restricted by Patents—Topeka Specifications—Sand Grading

By E. J. WULFF †

(Continued from July 20)

BITUMINOUS CONCRETE is coming into more and more general use on country roads and on streets in large towns and small cities. The general type is one having many variations and some of the chief of these are treated in this installment of Mr. Wuff's article. In the concluding installment certain important details of workmanship and control will be taken up.

Asphaltic Concretes

The true asphaltic concretes—that is, mixtures in which the coarse aggregate is united into a dense stonelike mass by a mortar composed of fine aggregate and asphaltic cement—are quite numerous. They include mixtures in which the coarse aggregate is comparatively large and constitutes about two-thirds of the entire mass, and mixtures in which the coarse aggregate is of a much smaller size and constitutes about one-third of the entire mass. These two represent the two extreme conditions, but there are other types, as well, in which the coarse aggregate constitutes intermediate percentages of the total aggregate with corresponding variations in the size of the coarse aggregate.

Asphaltic concretes occupy a middle ground between the asphalt macadams on the one side and sheet asphalt on the other, and are related to both.

Sheet asphalt is, par excellence, the recognized pavement in most of our large cities and sustains, with the exception of specialized heavy trucking, the comprehensive city traffic successfully. This success is due to the fact that a rational formula for the pavement has been developed and is understandingly enforced in most cases. As sheet asphalt is a pavement expensive in first cost, early attempts were made to reduce the cost by decreasing the depth of the pavement, hoping thereby to make it applicable to highways where the initial cost had to be considered to make them economically possible.

Without going into analytical detail the results of such changes were principally the addition of crushed stone to the surface course. In sheet asphalt, the mineral aggregate of the binder course

AN ASPHALTIC CONCRETE PAVEMENT ON FAIRVIEW ROAD, BUNCOMBE COUNTY, N. C.

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*From "Public Roads," the official publication of the U. S. Bureau of Public Roads, June, 1921.

†Senior Highway Engineer, U. S. Bureau of Public Roads.

AN ASPHALTIC CONCRETE MIXING PLANT

is crushed stone; the mineral aggregate of the surface course is sand and a filler composed of a very finely ground mineral dust. The chief function of the binder course, as the name implies, is to bind the surface course to the base course and to prevent the horizontal displacement of the surface course. The interlocking quality of the course aggregate of the binder course has prevented such displacement measurably even where the sheet asphalt surface, as such has not been of the best possible composition.

By incorporating the coarse stone into the wearing surface of a sheet asphalt mixture, it was found to be possible to decrease the depth of the pavement and, consequently, its first cost. The asphaltic concrete type of pavement is the outcome of these modifications and when the fine grading of the mixture approximates the rational formula of sheet asphalt the results have been satisfactory. These results have, however, been more or less accidental and examples of poor asphaltic concretes of both the coarse and small-aggregate types are quite common. Such failures are principally of two kinds. In the case of coarse-aggregate asphaltic concrete, the life of the pavement is much shortened by a poor grading of the fine aggregate which, being porous, admits water and causes the early oxidation of the asphaltic cement. It also permits displacement of the aggregate and causes uneven surfaces. In the small-aggregate asphaltic concrete, the first condition also exists and the displacement and readjustment of the mineral aggregate is much more pronounced and produces typical surface irregularities manifesting themselves in depressions and adjoining elevations of some extent as well as in narrow alternating ridges of comparatively small height.

LAYING ASPHALTIC CONCRETE WEARING COURSE

The underlying causes of these defects were early recognized in the small aggregate or Topeka type of pavements, and the grading of the material passing the 10-mesh sieve was modified in such a manner that the fine grading is now the same as in a standard sheet-asphalt pavement. This type is now known as modified Topeka pavement.

Use of Coarse-Aggregate Type Now Unrestricted by Patents

In the coarse-aggregate type the chief reliance for stability has always been placed on the coarse stone, and, as the specifications providing for the grading of the aggregate were protected by a patent, not much could be done heretofore to improve the specifications in regard to the grading of the fine aggregate. With the expiration of these patents, the coarse-aggregate type of pavement is open to unrestricted use, and the engineer has it within his power to modify the specifications along rational lines.

The asphalts used in asphaltic concretes are substantially the same as those used in the macadams, with the exception that the consistency is considerably stiffer. However, the climatic difference of the various sections is recognized in this type also, and the asphalts used in the northern section are softer than the ones used in the middle or southern belts. For the Topeka type of pavements the consistency of the asphalts is somewhat stiffer than for the coarse aggregate types in the corresponding climatic belts.

The mineral aggregate for asphaltic concrete is divided into coarse and fine. The coarse aggregate is composed of crushed stone, and the physical characteristics are measured by the same test standards as for macadam stone. It should be the best obtainable, economically, as the life of the pavement, apart from the grading, depends on the abrasive quality and toughness of the coarse material. As this type of pavement is usually laid to meet exacting traffic conditions, a stone as soft as is sometimes admitted in bituminous macadam without serious detriment should be rigidly excluded. The fine aggregate, for the purpose of proportioning, may be considered as all the material passing the 10-mesh sieve, and

(Continued on page 47)

GOOD ROADS

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ROAD AFFAIRS IN GEORGIA

News of what is described as "another effort to abolish the state highway department and put an end to the construction of the state highway system" is carried in a report from Atlanta, Ga.

The matter to which reference is made is the introduction in the Legislature of a bill providing for a reduction of the minimum fee for passenger automobiles from $11 to $5 and for the distribution of the motor vehicle fund among the counties on the basis of rural free delivery mileage.

It is charged that the reduction in license fees is a bid for the support of the owners of a popular priced car, "who are decidedly in the majority in Georgia," and that the proposed distribution of the motor vehicle fees "is meant to appeal to local cupidity."

Complete information—including the arguments on the other side of the controversy—are not in hand at this writing. The reports, however, indicate that Georgia road affairs are suffering one of the frequent disturbances created in an effort to decentralize road authority. Although it has been proven by long experience in state after state that efficient and economical road betterment must be carried on by state control of work on roads of state importance and local control only of work on roads of purely local importance, almost every state that has undertaken the improvement of a state system has had to cope with outbreaks similar to the one in Georgia.

WEST VIRGINIANS ARE BEING URGED TO "BUY A BOND"

Governor Morgan and the State Roads Commission of West Virginia are urging the citizens of that state to "Buy a bond and help pull West Virginia out of the mud," according to a recent report.

At the general election last year the voters authorized a bond issue of $50,000,000 for road betterments. The bonds bear 5% interest, are tax exempt, and are issued in denominations of $100, $500, $1,000, $5,000 and $10,000. At present $15,000,000 is being offered.

Difficulty in marketing road bonds has been the common experience of states and counties during the past year or so. This condition has been due to a number of causes, two of which stand out among the others. One is the low interest rate of public works bonds and the other is the adherence to traditional methods of marketing.

The first of these causes is the more difficult to overcome. The market is full of industrial, railroad, and public utility bonds of other kinds that are regarded as sufficiently safe by habitual investors and that yield much higher interest rates than any of the states and counties have offered. In a few cases attempts have been made to meet the situation by slight increases in interest rates. As a rule, however, reliance has been placed upon other and less effective measures. Frequently the issues have been sold at prices sufficiently below par to bring the yield to a figure attractive to buyers. The tax exempt feature has also operated to partly overcome the objection of low yield. Resort has also been had to the expedient of offering bonds in small denominations that are within the reach of those with but little money available for investment purposes.

The unwillingness of bankers and bond houses to underwrite public works bond issues is due, of course, to their inability to see sufficient profit in the business. Though they have learned some lessons from the Government's selling of Liberty and Victory Bonds, comparatively few of them have organized their forces to take anything like full advantage of the enormous aggregate buying power of the thousands of small investors—people with a hundred or a few hundred dollars to invest, who are contenting themselves with 4% at savings banks because they don't realize that their money can be made to earn any more.

The obvious way out is the way that West Virginia has adopted—and that has been urged repeatedly in these columns.

The seller of road bonds has two excellent lines of argument to use on prospective buyers. He can make a straight business proposition, for tax exempt bonds bearing 5% interest and backed by the credit of an American commonwealth are much more profitable than savings bank deposits paying 20%

less and subject to tax. And they are immeasurably better than the majority of the "investments" urged upon people of small means. He can also put the proposition on a basis of patriotism, pointing out that buying such bonds is the sort of patriotic action that will pay big dividends in increased land values, better living conditions and reduced commodity prices.

The plan being tried by West Virginia has succeeded elsewhere. Whether or not it proves successful in that state depends largely upon the methods adopted to put it over.

Safety Zones and Parking Regulations

(Concluded from page 42)

2. The dimensions as to height, width and length should be made to suit location, taking into consideration the traffic, number of people boarding street cars, and kind and style of cars that stop in the zone.

3. Safety zones should be lighted, either electrically or by acetyline or some other lighting device that would be dependable, but never with an inadequate light.

4. Street lights are not adequate to light safety zones.

5. Elevated safety zones should not be erected at other points than where car riders use them. Zones for pedestrians at such places can be designated by markings on the surface of the street or some other substantial way, such as tile, different type of brick, and so forth. There are several locations in Detroit where exceptions to this rule have been found advisable.

6. Elevated safety zones should not be used at crosswalks at or near the center of wide streets where traffic is heavy.

7. "Islands of Safety" elsewhere than at a street car stop should not be erected, except where there is special need for them.

Inspector Jackson states that in his opinion it is advisable to have the raised zone protected by red lights; that there be abutments on each end and that there be no railings or other attachments except lighting connections near the surface of the zone.

Regarding Parking

The immediate vicinity of all safety zones should be kept clear of obstructions, including standing automobiles, so that moving vehicles will have no excuse for encroaching on the safety zones and endangering pedestrians. In order to accomplish this the legislative body must give the police definite authority to regulate parking and ranking as related to safety zones. The following in effect is the provision contained in the traffic ordinances of most of the larger cities:

> No rule shall be deemed to prohibit a vehicle from parking at the curb of any street, while taking on or discharging passengers, freight or merchandise; but a vehicle may not stop for this purpose between a safety zone and the curb nearest thereto. NO VEHICLE SHALL BE PARKED BETWEEN A SAFETY ONE AND THE CURB NEAREST THERETO AT ANY TIME.

Parking should be prohibited at the curb alongside all safety zones a distance of about 10 ft. in addition to the length of the zone itself so as to afford more driving space between the parked vehicle and the entrance to the zone. If a safety zone is 150 ft. long, parking should be prohibited for a distance of 160 ft.

Loading and unloading of passengers or merchandise alongside safety zones should be prohibited. This does not impose any hardship, as the zones are almost always at the intersection of streets where there is other available space for this work without encroaching on the space alongside the safety zone.

There should be a uniform law enacted in every state establishing and regulating safety zones for car riders at street car stops. The following is offered as a suggestion for this purpose:

> To provide for a state law that will prohibit driving through a safety zone when it is occupied and that will designate a space for 6 ft. alongside the car track at all points where street cars stop for car riders, as comprising a safety zone, even though there are no marks or signs indicating that it is a safety zone.

The Detroit traffic ordinance contains such a provision so that there is a safety zone for every car stop.

It should not be necessary that safety zones at car stops be elaborately marked with signs to notify the driver of the existence of such zones, for the reason that any marking that is sufficient for car riders should be regarded as sufficient for motorists.

The most effective way of enforcing parking regulations without using an excessive number of officers is by means of a law such as the Detroit traffic ordinance, the salient points of which are as follows:

An automobile pound to which can be towed vehicles parked on crosswalks, opposite safety zones and elsewhere where they are a serious obstruction; and others which violate the regulations can be tagged. This tag notifies the motorists to immediately pay a fine, $1 for the first offence, $3 for the second, $5 for the third and any subsequent violation, with the alternative of being summoned to court.

The parking of a single row of automobiles at each curb where parking is permitted for an indefinite period of time is not in any sense a police problem. It is immaterial to a police department whether a parking space be used by one automobile or by a dozen of them during the day. In the business section it does however interest the persons who are maintaining the business places and who want their customers to have access to the curb. It becomes a police problem only when over-time parking results in vehicles standing in the street outside of the permitted parking place, comprising double parking, so called. Such a congested condition is the cause of extensive delays and many accidents, in order to avoid which, the enforcement of the parking time limit is necessary.

West Virginia to Sell Road Bonds to Small Investors

Governor Morgan has appealed to the people of the state to buy $15,000,000 of state road bonds, issued in denominations of $100, $500, $1,000, $5,000 and $10,000. "Buy a bond and help pull West Virginia out of the mud," is the slogan being used. The bonds bear 5% interest and are tax exempt.

No Action on Federal Aid Legislation

No action has been taken on federal road legislation pending in Congress, according to the most recent reports and, because of animosity existing between the supporters of the Townsend Bill and the supporters of the Dowell Bill, and a depleted national treasury, it grows more evident that Congress will probably adjourn without enacting any road legislation.

A special dispatch from Washington states that the Committee on Post Offices and Post Roads met yesterday and will probably report out this week an amended bill providing for a federal highway commission and a system of national highways, but carrying no appropriation.

Transportation Committee of the U. S. Chamber of Commerce

Appointment of a General Departmental Committee and a Special Railroad Committee Announced

The Chamber of Commerce of the United States has announced the appointment of two committees to deal with transportation matters during the coming year.

One is a general departmental committee for the chamber's department of transportation and communication. It will deal with problems relating to the general field of transportation and communication. The other is a special body to study mtaters of rail transportation.

The chairman of the departmental committee is Howard Elliott, Chairman of the Board of the Northern Pacific Railroad. The vice chairman is Lewis B. Stillwell, a consulting engineer of Lakewood, N. J. The member for highways is A. J. Brosseau, President of the International Motor Co.

George A. Post, President of the Hudson River Bridge Corporation, New York, N. Y., is chairman of the special railroad committee.

The chamber's transportation department was organized recently and J. Rowland Bibbins, formerly supervising engineer with the Arnold Company, of Chicago, was made manager. The department will deal with transportation in all its forms, including the economic analysis of the problem of highway transport in relation to other agencies, "and was the proper public subsidy therefor."

Missouri Still Legislates

Although the Missouri Legislature has been in regular and extra session since the general election of last year, when a $60,000,000 road bond issue was authorized, little has been accomplished in the way of road legislation. Some factions want hard-surfaced roads, others gravel; some want the work to proceed under the direction of the State Highway Commission, others want the funds divided among the counties. Numerous bills have been introduced incorporating the above ideas; and peanut politicians continue to block road development in the state.

Asphalt and Oil Put on Free List by the House

With asphalt and crude oil remaining on the free list, the Fordney Bill passed the House of Representatives on Thursday of last week.

As noted in "Good Roads" of July 20, great opposition was manifested to the imposition of a duty on these materials. President Harding entered protest against a tariff on oil, thus supporting the American Automobile Association and other organizations that had aligned themselves on the side of American producers operating in foreign fields. Chairman Fordney of the Ways and Means Committee is quoted as having admitted that the sentiment against tariffs on asphalt and oil was "overwhelming."

Early action by the Senate is not expected.

Bituminous Macadam and Bituminous Concrete Pavement Construction

(Continued from page 44)

may to advantage include both screenings and sand as well as a fine mineral dust usually designated as "filler."

In combination with asphaltic cement and provided that the fine aggregate and dust are properly proportioned, it forms the mortar that fills the interstitial voids of the coarse aggregate in the completed pavement. In asphaltic concrete considerable dependence is placed upon the interlocking action of the coarse aggregate against displacement, and where the coarse aggregate constitutes nearly two-thirds of the entire mass of the pavement very little displacement need be apprehended, but the quality of the mortar determines whether the pavement is short lived or whether its usefulness shall extend over many years.

In the Topeka type of pavement, where the coarse aggregate constitutes barely one-third of the mass of the pavement, this amount is not entirely sufficient to place the stones in close enough contact to prevent displacement, and the angular fragments of crushed rock passing the 10-mesh sieve supplement that essential quality measurably. While, therefore, screenings are not so essential in coarse-stone concrete, they should by all means be included in the fine aggregate of the Topeka types, and sand should be employed only to supplement the deficiency of fine aggregate.

It occasionally happens that a stone in crushing will produce only a small amount of material passing the 10-mesh sieve, in which event the deficiency would have to be made up with sand. In other cases that have come under the writer's observation the prevailing limestone rock was so soft that all the material passing the 10-mesh sieve was rejected as unsuitable. Such pavements are liable to distortion much more than where the screenings constitute a substantial part of the fine aggregate.

Topeka with Binder Course Uneconomical

The expedient in such cases has been frequently to place the Topeka pavement on a binder course, resulting in a form of construction similar to sheet asphalt pavement. While this binder course may measurably prevent excessive displacement, the method appears scientifically and economically unsound. In this case the cost of the Topeka type of pavement would be substantially the same as that of a sheet asphalt pavement, while its period of usefulness must of necessity be much shorter owing to the greater abrasion of the soft stone in the Topeka than of the fine sand grains in the sheet asphalt, all other conditions being equal.

With the expiration of the patent rights above referred to, which determined the amount of coarse aggregate in the Topeka types at not exceeding 32% by a decision of the United States Courts, the percentage of coarse stone may now be safely increased and this would tend to produce greater stability. In fact, the coarse aggregate may now be proportioned to any intermediate percentage between 32% of the modified Topeka and the maximum of about 67% of the large aggregate types. With an increase in the percentage of stone the size of the stone should be correspondingly increased.

Another essential requirement for the fine aggregate is a finely ground mineral, usually consisting of ground limestone or Portland cement, although other ground minerals, if commercially available and of the required fineness, may be used. The essential quality of this dust, usually designated as filler, in addition to fineness, is angularity, such as would be produced by grinding. Experience has shown that an equally fine material, produced by water or wind action, as occurs occasionally in fine sand, has not the essential qualities and should not, therefore, be considered as an equivalent or a substitute for ground dust. For that reason a limit, usually about 6%, is placed upon sand particles passing the 200-mesh sieve, although as high as 12 and 15% of ground dust, including fine sand passing the same mesh opening, may be required in the fine aggregate when properly combined. The reason for this requirement as well as a definite grading of the aggregate for asphaltic concretes is deserving of a more detailed explanation, as the success of these pavements depends essentially upon the quality of the asphaltic mortar in the concrete.

If we first consider the physical qualities of most sands, we find that they are composed of grains that may be more or less angular, but are in any event more or less rounded at the corners, due to the abrasive action of grain upon grain in the process of formation. Consequently, the grains move more or less freely against each other under pressure. This applies to sands of uniformly sized grains and sands that are composed of differently sized grains; not, however, with equal force. If these sand grains are bound together with asphalt cement they are held in position if no pressure is exerted. If pressure is exerted, particularly when the asphaltic cement becomes more or less plastic under summer temperatures, the sand granules are displaced and readjust themselves in new positions. If the sand is coarse, or of a too uniform size, the asphalt bodies are large and the readjustment of particles under pressure is excessive.

Character of Sand Grading Recommended

If we conceive a sand grading in which the voids formed by adjacent sand particles are successively occupied by other sand particles decreasing correspondingly in size, and the smallest voids remaining are occupied by an angular dust, we have then a grading in which the voids have been eliminated as far as it is practicable to do so. Such a grading is used in the present standard sheet asphalt, in the material passing the 10-mesh sieve of a modified Topeka pavement, and in the fine material aggregate of a coarse-aggregate asphaltic concrete as required by the Bureau of Public Roads in its new typical specifications as well as in the specifications of the Asphalt Association.

If we further conceive the voids filled with asphaltic cement, the angular dust will largely prevent an excessive displacement or readjustment of the sand particles even if the summer temperatures make the asphaltic cement more or less plastic.

Another very important effect of the density of this grading lies in the fact that it produces an essentially waterproof mortar which is, therefore, not affected by percolating water or air and the consequent weathering action on the asphaltic cement. The latter, in turn, retains its plastic and ductile qualities for much longer periods than it would in a porous mixture.

In essence, the permanency of an asphaltic pavement and its resistance to displacement depend chiefly upon the rational grading of the mortar, and this applies with equal force to sheet asphalt

(Continued on page 53)

Road Will Open up Oregon Caves

Bids were recently received by the U. S. Forest Service for the construction of a road to the Oregan Caves in Josephine County, Oregon. John Hampshire, of Grants Pass, Ore., submitted the low bid of $126,862, which has been referred to the Secretary of Agriculture with the recommendation that it be accepted. This road will make the famous Oregon Caves accessible to tourist traffic.

Plan Bridge Over San Francisco Bay

Plans for a bridge over San Francisco Bay have been prepared by Gustav Lindenthal, and A. J. Rich, a San Francisco financier, has announced that money to carry out the project can be raised without difficulty. Chambers of Commerce and the San Francisco Motor Car Dealer's Association are supporting the movement. San. Francisco Bay has been termed the "Chinese Wall" of the city; passenger ferries taking 20 min. and vehicle ferries taking 45 min. to travel to or from the mainland.

Hatt Appointed Director of Advisory Board on Hghway Research

W. K. Hatt, Professor of Civil Engineering at Purdue University, has been appointed director of the Advisory Board on Highway Research of the National Research Council.

This board was formed last year and includes in its membership 11 societies, the Federal Highway Council, the Engineering Foundation, the U. S. Bureau of Public Roads, 13 state highway departments and 40 universities.

The Advisory Board on Highway Research does not conduct any research work, but aims to coordinate the work being done, acting also as a clearing house for information.

Bills Would Cripple Georgia State Highway Department

Three bills have been introduced in the Georgia Legislature which seek to put the skids to the plan of the State Highway Department to build a state system of highways. These bills have been introduced by Representatives McMichael, Davis and Beck, and are similar in purpose. The bill introduced by Mr. Beck provides for a reduction of the minimum fee for passenger automobiles from $11 to 5 and for a distribution of the motor vehicle fund among the counties on the basis of R. F. D. mileage.

Supporters of the department are laying their plans to fight to the last ditch against efforts to interfere with the construction of the highway sysem. As originally mapped out, the system will embrace 4,900 mi., of which approximately 25% has been constructed.

Warner-Quinlan Asphalt Plant Burns

The plant of the Warner-Quinlan Asphalt Co., at Linden, N. J., was destroyed by fire on July 18. The plant had 15 stills and 34 tanks, many of the latter exploding and scattering the burning oil over several acres of marshlands.

Missouri May Increase Motor Fees

A bill has been introduced in the Missouri Legislature by Senator Ralph which provides for increasing motor vehicles fees to obtain a road maintenance fund. Under the terms of the bill passenger automobiles will pay from $4 to $26 and motor trucks from $8 to $24.

South Dakota to Spend Several Millions

South Dakota will spend several million dollars this year in building gravel roads to connect cities in the eastern part with those in the western part of the state. Last year the state constructed 320 mi. of gravel road, expending $2,377,617.

An appropriation of $3,000,000 has been voted by the Legislature for the construction of a cement mill.

Louisiana to Build Roads Without Bonding

The Louisiana Constitutional Convention has closed its session, after having adopted a pay-as-you-go plan for the construction of a state system of highways.

No bonds will be issued for road construction, but the revenue derived from increased motor vehicle fees and a gasoline tax will be used. The minimum fee for passenger cars is placed at $15 and for trucks, $25. A 2-ct. tax per gallon on gasoline will be levied.

It is estimated that these taxes will yield $4,000,000 to $5,000,000 dollars annually, which, added to funds raised by local districts, will make about $10,000,000 available annually for road work. The Legislature will fix the scale of motor fees at the session next fall.

◆

Mayor Moore, of Philadelphia, Pa., has signed an ordinance authorizing the paving of 74 streets, involving an expenditure of approximately $1,000,000.

Durham, N. C., Plans to Spend $250,000 on street work this year. It is estimated that 60,000 sq. yd. of pavement and 15,000 sq. yd. of sidewalk will be laid.

The New Jersey State Highway Department recently refused to permit Pennsylvania to place detour signs on New Jersey roads. The Pennsylvania State Highway Department is constructing a road near the state line.

Massachusetts Highway Association

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Announcement

This section of the paper is open to members of the Massachusetts Highway Association for the discussion of matters directly connected with road interests. Members are requested to submit items of interest for use in this column.

Address all communications to GOOD ROADS, P. O. Box 2705, Boston.

The annual convention of the Federation of State, City and Town Employees' Unions will be held in Hibernian Hall, Woburn, beginning Aug. 27, according to a notice sent recently to all affiliated unions by President M. F. O'Brien, who appeared at a meeting of the Boston Park Department Employees' Union 172 and addressed the members.

The convention is expected to be in session for several days. Each local is entitled to five delegates, who must be bona fide state, city or town employees. Locals are requested to send lists of delegates elected, so that they can be given committee places for announcement on the opening day.

In discussing the convention, President O'Brien declared that the convention would be momentous for every state, city and town employee, as it would deal with wages, hours and working conditions, which, he said, were of vital concern to each and every member and his family. "The movement to lower wages and increase working hours," he said, "is now being fostered and spread by the foes of all organized bodies, so that we must be on our guard to prevent it. And we can only do this if we are united in this, 'our common cause.' "

The meeting of Local 172 voted to request the Metropolitan District Commission to re-employ laid-off employees, especially those with four years' standing, or better, in the service. The committee on conditions was instructed to visit the commission on a matter of vital importance, and it was voted to send a letter of thanks to G. L. Rogers, secretary of the commission.

Praiseworthy community spirit, coupled with the best of cooperation from private individuals, concerns and public officials, have made it possible to reconstruct the Point of Pines Bridge over the Saugus River in record breaking time. When a fire destroyed the Lynn end of the bridge on the morning of June 17, the Metropolitan District Commission lost no time in considering plans to restore it. The engineering department worked night and day and soon had plans ready for a permanent, fireproof concrete and steel bridge. Then the board voted to build it.

Meanwhile the General Electric Co., which has one of its largest plants in Lynn, offered to rebuild the bridge and have it ready about July 15. Mayor Creamer, of Lynn, with the support of other officials and of local civic organizations, offered to pay the bills with the understanding that later the Legislature would appropriate the money to reimburse the city. Governor Cox and the commission offered to use their influence to that end. The City of Lynn then set apart $40,000, but some $5,000 less will be required.

At the time the commission received bids from contractors for replacing the bridge with a permanent one, the General Electric-City of Lynn offer was taken up. Since building the permanent structure would have meant holding up traffic on the principal route to the North Shore until Jan. 1, 1922, at the least, the commission lost no time in accepting the offer for quick work on a temporary bridge.

On July 5 the General Electric Co. started work, detailing its own engineers to look after it. After the work was started it was decided, with the approval of the Metropolitan District Commission, that it would be better to remove the wreckage of the old bridge immediately than to leave that work until the new bridge was completed. This required three days that had not been included in the time estimate, but will save a considerable sum and will make the river more nearly free from obstructions. Ever since the wreckage was cleared away the work on the bridge has been forced about as fast as the most rosy estimates called for. It is claimed that the bridge, which is of the same size as formerly, will be stronger than ever.

With the bridge again in use, the time during which travel to the North Shore will be handicapped will be shortened by 166 days, or nearly half a year—and the busiest half at that. The feat constitutes a memorable record in bridge building and one that reflects credit on all concerned.

Two important state highway improvements have been completed recently and two through routes that are in great favor with motorists are once more open to the public. One of these is the route between

Boston and Plymouth via Hanover. This route, 7 mi. shorter than the shore route and practically free from dangerous curves, has been reconstructed or resurfaced in part and is now in fine means of reaching the festivities at Plymouth.

The other is the Newburyport Turnpike, which, while not yet open throughout its length, at present has only one detour and that over roads that are in fine condition. Northerly from Boston, the turnpike is open to South Lynnfield, the Saugus-Lynfield reconstruction having been completed. At South Lynnfield it is necessary to detour through Peabody, but the surface of the detour is in good condition. The detour is 8 mi. long, but adds only 4 mi. to the trip over the turnpike, so that for those going to Newburyport or beyond it presents the shortest route.

The so-called inland route to the north, through Andover and Haverhill, is in fine condition throughout, the reconstruction on Main St. in Salisbury having been completed. Another piece of resurfacing, south of Andover, has been completed also, leaving the route clear throughout its length.

Reconstruction work has been commenced in Winchester on the Boston-Lowell route and all traffic is diverted through Winchester Centre and Woburn. Motorists going from Boston to Lowell have several alternative routes. It is expected that work will be commenced soon on the resurfacing of Atlantic Ave. in Marblehead and Swampscott.

New York State Road Builders' Association

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Crusher Run

The New York State Commission of Highways, through its representative, Joseph Donnelly, has petitioned the Public Service Commission for an order to make alterations in the crossing of the Saugerties-Catskill state highway and the West Shore R. R. in the town of Catskill.

Eighty-four bids were received on the 17 jobs included in the letting held on July 6. The total amount of the contracts awarded was $1,127,266, the work being in Cayuga, Hamilton, Livingston, Monroe, Niagara, Rockland, Steuben, Warren, Yates, Clinton, and Otsego Counties.

Fourteen proposals were received on the Victory-Red Creek job in Cayuga County and 12 on the Tompkins Cove-West Haverstraw job in Rockland County.

The Spellman-Oliver Co., Chateaugay, received the contract for the Victory-Red Creek Road, Parts 1 and 2, in Cayuga County. The road is 5.39 mi. long. The bid was $162,327.50 and the engineer's estimate was $184,679.75.

Wm. L. Sherrill, Hudson Falls, was awarded the contract for the Erwin-Lawrenceville Road in Steuben County at a bid of $184,899, the engineer's estimate being $192,204.25.

Louis Mayersohn, Albany, was awarded the contract for the Main St. job in Chestertown Hamlet, Warren County. His bid was $3,538.85 and the engineer's estimate was $3,738.75.

DeGraff & Hogeboom, Kingston, and the Greenfield Construction Co., Hornell, were awarded repair contracts in Clinton and Steuben Counties.

The letting on July 13 was also a very spirited one, the 18 contracts advertised attracting 111 bidders.

Eighteen bids were received for the Naples-Middlesex Road in Ontario and Yates Counties. The lowest bidder was the Carey-Campbell Co., Inc., at $338,166.62. The highest was the American Pipe & Construction Co., Philadelphia, Pa., at $370,336.10.

The low bid on the DeFreestville-West Sand Lake Road in Rensselaer County, made by the Troy Paving Co., was rejected because it did not contain unit prices. The contract was awarded to the L. D. Sullivan Co., Inc., Utica, the next lowest bidder, at $87,276.50.

The awards on 10 contracts have been deferred until the Commission receives the approval of the Federal Government.

The Appelate Division of the Supreme Court, Fourth Department, has handed down a reversal of the decision of the Court of Claims in which the latter declared unconstitutional the provisions of the Knight Act. This measure authorized the cancellation of contracts begun before the war and provided for the compensation of contractors for work done.

Jeremiah Finch, formerly of Potsdam, who has been acting secretary of the New York State Commission of Highways, has been appointed permanently by Commissioner Sisson. His salary is $5,000 a year. Mr. Finch acted in an advisory capacity with the special legislative committee, headed by Senator Charles J. Hewitt, which prepared the Hewitt Bill providing for the 11,000-mi. state highway system. He was made acting secretary when Commissioner Sisson assumed office.

The Lafayette Road in Suffern is the first state highway completed since Commissioner Sisson took office. The formal presentation of the completed road to the village was made the occasion of a three-day celebration at which Governor Miller and Commissioner Sisson were guests of honor. For five years Lafayette Ave. has been almost impassable, forcing motorists to detour and preventing access to some of the state's most historic territory. The road now completed is considered the most beautiful one in the Ramapo Valley.

New Hampshire Good Roads Association

OFFICERS FOR 1921

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Francis A. Saunders, Highway Agent of Hillsborough, died on July 12 from injuries sustained when he was struck by the town truck.

At the time of the accident Mr. Saunders was with the road crew about 6 mi. from the town. He stepped off the truck while it was moving and the truck body struck him in the back, crushing his kidneys.

He was carried to his home and later an attempt was made to take him to a hospital in Nashua, but he died on the way.

Mr. Saunders leaves a widow and one daughter.

Two 2½-ton trucks and one 6-ton truck are to be added to the sprinkling equipment of the Manchester Highway Department at once, according to a recent statement by Joseph Quirin of the department.

The department was handicapped early in the season by the lack of adequate equipment and the aldermen recently authorized the expenditure of $25,000 for new trucks. According to Commissioner Quirin, the purchase of the three new machines will not require the entire amount.

Commissioner L. J. Farrell confirmed the report of the purchase of the trucks, but declined to comment upon the types selected or the expenditure required.

The Lovejoy Granite Co., of Milford, has begun the construction of the stone bridge on the Daniel Webster Highway over the Souhegan River at Merrimack Village and the selectmen, by authority from the highway commissioners, closed the road to traffic on June 23 and 24 and to all loads of over 5 tons during the progress of the work. It will be well into the fall before the bridge is completed.

With the placing of a 6½-ton sprinkling and flushing truck on the streets of Manchester, the Highway Commission of that city has accomplished its object of providing one of the best sprinkling and flushing systems possessed by any city in the United States.

The new machine has a capacity of 1,500 gal., and, with the two smaller trucks now on hand, assurance is given that Manchester will not suffer from any lack of sprinkling and flushing facilities.

The new truck was rushed to the city on special order. Because of the energy displayed by the members of the Highway Commission, the new equipment was secured in less than three weeks, though it ordinarily takes about three months to secure such machinery.

Manchester's tax assessors have announced a tax rate for 1921 of $2.45 on the hundred, as compared with a rate of $1.82 for 1920. The new rate is the highest in the history of the city and, despite the expectation of a large increase, exceeds by 20 ct. the prediction of a rate of $2.25.

At the same time there was announced an increase in the total valuation of approximately $800,000. Definite figures were not furnished, because the State Tax Commission has not yet visited the city and inspected the assessors' books. When this inspection is made the valuation may be either increased or decreased. Last year's total valuation was $109,454,552.

The only consolation the assessors offer taxpayers is the fact that Manchester is not alone in the matter of high rates, Portsmouth paying $3.26.

Of the amount to be raised by taxation, Manchester will contribute $359,669 plus an overdraft of $95,206.50 for schools, or a total of $454,875.50 to the state and $165,641.50 to the county.

As the exemption from taxation on the McElwain factories and power house on the west side of the railroad tracks ceased last year, the revenue obtainable from that source accounts for a part of the increase in total valuation.

Work on the new Amoskeag Bridge in Manchester will commence immediately, according to George C. Shedd, President of L. H. Shattuck, Inc., the firm that was awarded the contract for the work on July 16 at a bid of $126,000, the lowest of ten. The work will be rushed to completion at the earliest possible date.

Though $190,000 was appropriated for the work by the city government, based on reports made under another regime that the bridge would cost at least that much, and probably more, under present conditions approximately $50,000 will be saved to the city, including fees to engineers and other extra costs. Fay, Spofford & Thorndike, the engineers in charge of the job, will receive 10% of the contract price, or $12,600, making a definite total of $138,600.

The "business not politics" policy of the new finance and highway commissions in bringing about a situation in which the city will be returned a considerable sum on a major contract—something the city has not experienced in years—appears to be, in the public mind, more than justification for their creation by the Legislature, according to general comment. The number of bids and high character of the bidding firms also is considered indicative of the business-like methods followed by the commissions.

The new Amoskeag Bridge will be about 750 ft. long, with a 20-ft. roadway of bituminous macadam and granolithic sidewalk 6 ft. wide. Though the new bridge will not be as large as the old Granite Bridge, comparative figures are not amiss. The Granite Bridge, built in 1896 under Mayor Clarke, cost $130,000, while the new structure will not cost a great deal more despite the difference in the cost of building at the present time.

Another fact particularly pleasing to the public is the promptness with which it will be opened to traffic. According to the contract, the new bridge must be open to pedestrians not later than Nov. 22 under a $100 a day penalty. All work except the roadway pavements must be completed by that time and the entire structure must be ready for the formal opening not later than Dec. 10.

The following bids were received for the work: American Bridge Co., Boston, Mass., $134,250; Bethlehem Steel Bridge Co., Bethlehem, Pa., $145,700; Boston Bridge Works, Boston, Mass., $136,478; Lupfer & Remick, Buffalo, N. Y., $131,000; McClintic-Marshall Co., Boston, Mass., $136,378; Daniel O'Connell Sons, Holyoke, Mass., $140,000; Phoenix Bridge Co., Phoenixville, Pa., $136,740; L. H. Shattuck, Inc., Manchester, $135,775; Louis J. Seiling, Red Bank, N. J., $135,775; Shoemaker-Satterthwait Bridge Co., Pottstown, Pa., $128,590.

The largest number of requests for plans of the proposed structure ever made in the history of the city for a similar undertaking reached the highway commission before the date for the closing of the bids. Twenty-eight different concerns were furnished with the plans.

The bids were opened in the presence of the highway commission, the finance commission, the city clerk, the highway supervisor, and various other city officials.

Bituminous Macadam and Bituminous Concrete Pavement Construction

(Continued from page 48)

where the entire paving surface is composed of this asphaltic mortar as well as to the asphaltic concretes where the mortar unites the coarse stone into a monolithic mass.

It follows that the grading requirement of specifications must be followed closely if success is to be obtained, and that disregard of such requirements either through ignorance or carelessness can only have disastrous effect, as is evidenced only too frequently and more particularly on country highways. In our larger cities the practice of building asphalt pavements appears to be much better understood. Their greater success is due to competent inspection and enforcement of specification requirements. This inspection is comprehensive in cities and covers every phase of manipulation. On country roads, on the other hand, inspections are frequently performed by men who have no understanding of the subject, and still more frequently the only attempt at control consists in forwarding a daily sample of the mixture to some testing laboratory. Constant inspection and control, both at the mixing plant and on the road, are essential; and the inspection should be done by men experienced in this type of construction and who have a rational understanding of the requirements and are capable of making the comparatively simple tests required in the field.

The laboratory equipment at the plant to be used by the inspector should consist of the necessary laboratory sieves and scales so that the composition of the sand may be quickly determined and controlled. A penetrometer and an extractor may be desirable under certain conditions, and a thermometer is an essential part of the inspector's equipment.

(To be concluded)

MEETINGS

Calendar of Coming Meetings

Aug. 30-Sept. 1—Michigan State Good Roads Association.—Annual meeting, Flint, Mich. P. T. Colgrove, Pres., Hastings, Mich.

Oct. 24-28—American Society for Municipal Improvements—Annual Convention, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Highway and Highway Transport Education Committee

A conference on highway and highway transport economics will be held by the Highway and Highway Transport Education Committee of the U. S. Bureau of Education on July 27 at the University of Maryland. No formal papers or addresses will be given, but discussions will be held informally on highway valuation, finance, construction, maintenance and transportation. Special attention will also be given to the consideration of providing material for college courses in highway economics and highway transport.

C. S. Howe, President of the Case School of Applied Science, will preside.

Illinois State Association of Highway Commissioners and Town Clerks

The twelfth annual convention of the Illinois State Association of Highway Commissioners and Town Clerks will be held in Springfield, Ill., on Aug. 24 and 25. The sessions will be held during the two mornings, so that delegates may attend the Illinois State Fair in the afternoons.

Texas Road Builders' Association

The Texas Road Builders' Association held a meeting in Austin, Tex., on July 20. W. R. Scott, President of the Southern Pacific Lines, spoke on, "The Attitude of the Railroads Towards the Good Roads Movement." Other speakers were Lieut. Governor Davidson, Earle B. Mayfield, Representative B. F. Johnson and J. D. Fauntleroy, of the U. S. Bureau of Public Roads.

PERSONAL MENTION

F. E. Ross has been appointed city engineer of Jefferson City, Mo.

D. E. Wright has resigned as municipal engineer of the Canal Zone.

George W. Green has been appointed municipal engineer of the Canal Zone.

J. P. Wehrung has been appointed county engineer of Runnels County, Texas.

C. F. Hickok, City Engineer of Alameda, Cal., has been appointed city manager.

H. F. Anderson has been appointed road engineer of Mecosta County, Michigan.

Virgil W. Sams, at one time city engineer of Pocatello, Idaho, has been appointed surveyor general of Idaho.

William F. Brock has been apopinted highway engineer by the U. S. Bureau of Public Roads, with headquarters at Jackson, Miss.

E. E. Sours, formerly road engineer of Mecosta County, Michigan, has been appointed road engineer for Allegan County, Michigan.

R. O. Gallagher, formerly Superintendent of Roads of Hamblen County, Tennessee, is now resident engineer for the Tennessee State Highway Department.

A. H. Terry, of Bridgeport, Conn., has been appointed consulting engineer by New London, Conn., for the construction of a bridge on Crystal Ave.

Ralph Modjeska, of Chicago, Ill., has been appointed chief engineer for the Delaware River Bridge between Camden, N. J., and Philadlphia, Pa.

V. L. Ostrander has been appointed assistant to Fred W. Sarr, First Deputy Commissioner of Highways of New York. Mr. Ostrander has been assistant engineer with the commission since 1911.

Elwin Quinney, formerly county highway superintendent of Beadle County, South Dakota, has been appointed resident engineer by the South Dakota State Highway Department, with headquarters at Watertown.

◆

Colbert County, Alabama, recently voted a road bond issue of $200,000.

Seven Bridges over the Sacandaga River, N. Y., were washed out during a cloudburst.

The Province of Saskatchewan, Canada, plans to spend $2,329,248 for road work during the present year.

Ward 5, Vernon Parish, Louisiana, recently sold $250,000 of road bonds at par to W. M. Elkins Co., of Little Rock, Ark.

Henderson County, North Carolina, recently purchased $15,000 of road machinery, to be used in carrying out its extensive road program.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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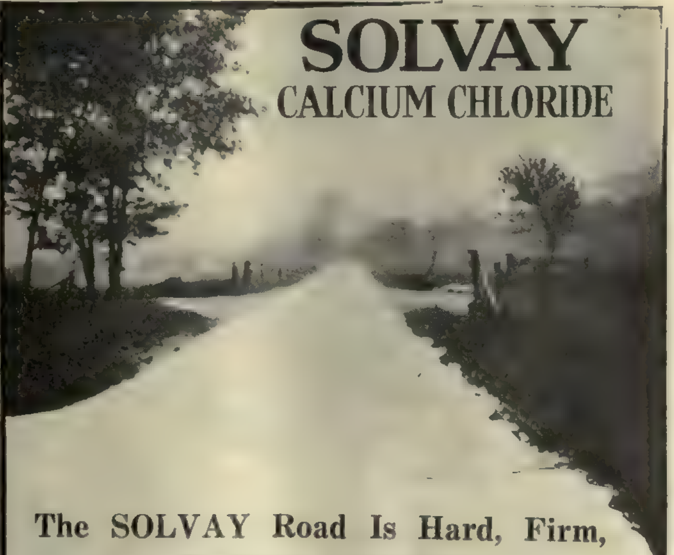

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GOOD ROADS

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WITH WHICH IS INCORPORATED

THE HIGHWAY CONTRACTOR AND ROAD BUILDER

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Contractors' Plants for Asphalt Paving Jobs—I*

Unloading, Storing and Loading Aggregates—Handling and Heating Asphalt—Mixing Asphaltic Concrete—Hauling—Placing and Spreading

By HENRY B. DROWNE†

Unloading, Storing and Loading

On jobs which require the shipment of stone in railroad cars, the method of unloading them has to be considered. If a coal trestle can be found near the work, it is usually possible to make an arrangement with the owner for the use of the trestle so that the cars can be unloaded from it. Stone cars with some form of bottom dump are necessary to work such a proposition advantageously, but they can usually be obtained without trouble. If a coal pocket can be obtained in conjunction with the trestle, so that the stone can be run from the cars into the pocket and run from the pocket into the wagons or trucks which are to take it to the work, it makes an ideal loading method and one of the cheapest. If no pocket is to be had, a hopper may be built sometimes under the trestle at small expense which will give practically the same results as the pocket. A similar scheme can be worked out sometimes where a siding runs along the top of the bank with a road parallelling the siding at the foot of the bank. A hopper built at the top of the bank below the bottom of the cars and connected with the road level by means of a chute will make it possible to load conveyances on the road level in a rapid manner. Considerable

AGGREGATE STORAGE ON A BITUMINOUS ROAD JOB IN PENNSYLVANIA difference in elevation is necessary to work this scheme, as stone will not rapidly run in a chute unless the drop is at least 12 in. to the foot. A considerable saving over unloading by hand can be made if the stone is dropped from the cars into storage piles underneath the trestle and then reloaded into wagons or trucks by means of a steam shovel or other mechanical loader.

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*Extracts from "Suggestions for Asphalt Paving Contractors," published by the Asphalt Association, New York, N. Y.

†Division Engineer with the Lane Construction Corporation.

There are several makes of loaders that will load from stock piles economically and rapidly. A low priced machine also suitable for such kind of work is a small belt conveyor driven by a gasoline engine. This machine is mounted on a 2-wheel truck, is light, and can be easily moved. Sufficient elevation can be obtained so as to load into trucks. It is necessary to feed material to the belt by hand and the output of the machine is governed largely by the rapidity with which the feeding is accomplished. A belt conveyor will not load as cheaply as some of the self-feeding loaders, but it will considerably reduce the cost of doing the work by hand alone. A hoist with a clamshell bucket may be used to load from stock piles or out of the cars direct. Many of the steam shovels are now built so that a clamshell can be operated from the shovel boom. If a clamshell is used, it is necessary to use some hand labor in the cars to trim the stone away from the sides and end of car so that the bucket can reach it.

PLANT SELECTION AND LAYOUT play a vital part in contracting, especially in bituminous pavement work. Proper equipment, chosen wisely and installed correctly, increases profits for the contractor and enables him to handle a greater volume of work.

AN ENGINEER WITH CONTRACTING EXPERIENCE in one of the leading building concerns prepared the following treatise for general distribution by the Asphalt Association among contractors engaged in the construction of asphalt pavements. Only those portions of the discussion dealing with equipment peculiar to bituminous work are reprinted here.

Another outfit which will unload stone direct from the cars is the bin and elevator. One of the best arrangements of this type consists of a 50-ton knockdown bin and bucket elevator. (See Fig. 1) A narrow chute is built under the track with a gate in the lower end of it that allows the stone to drop into the buckets at any desired rate. The stone is elevated into the storage bin and can be loaded into wagons or trucks from the bin by gravity. A gas engine or electric motor provides power for the elevator. The storage bin offers several advantages. It provides a small reserve supply of material; the process of unloading and the method of hauling do not have to be so carefully coordinated; in the event of a breakdown in the loading equipment a supply of material is available while the necessary repairs are being made; demurrage on cars is largely eliminated, and it is sometimes possible to obtain a greater output with less hauling equipment. The stone must be shipped in bottom dump cars and is unloaded by dumping a pocket of a car over the chute underneath the track, thus allowing the stone to flow to the bucket line. Considerable room is required to operate on outfit of this kind successfully. Sufficient length of tracks must be had so that the cars can be pushed down by the chute and as the side of the storage bin on which the trucks are loaded is about 26 ft. from the rail, a width from the track of about 35 ft. will be occupied in loading. If the right kind of stone cars can be obtained, this outfit will unload stone very cheaply and usually much faster than it can be drawn away economically. Two live men about the plant to look after the engine and move the cars are usually all the labor needed.

Handling and Heating Asphalt

Asphalt is furnished on the job in one of three ways, as follows: In barrels or drums, in tank cars, and in tank trucks. The type of construction and the equipment at hand will determine the best method to adopt. Material delivered in tank cars costs usually 2 to 4 ct. less a gallon than material furnished in barrels or drums, and where the amount of material to be used is large, tank car deliveries should be taken advantage of. Work which is situated near a distributing station of an asphalt company can be supplied with the asphalt, cheaper, usually, than in any other way, by hauling the hot asphalt in tank trucks direct from the plant. Barrel shipments are warranted only when the quantity to be used is less than a tank car, or service from the distributing station can not be obtained. In hot mix work it may be more convenient, in some cases, to have the asphalt shipped in drums. As an illustrative case: When railroad transportation was uncertain, if all the asphalt required were shipped to the work in drums, and stored, no delays would be incurred in waiting for asphalt, which might be the case if shipments were made in tank cars.

When asphalt is shipped in tank cars, steam for heating same can often be supplied from the boilers of some plant alongside the siding on which the car is placed. The expense of such arrangement is usually not great, and as such boilers carry a higher pressure and have a larger steam capacity than the portable boiler used by the contractor, the asphalt is heated more rapidly. Where such arrangement can be obtained, a portable boiler or a road roller may be piped up to the car. The higher the steam pressure, the greater the efficiency obtained in heating. A 20 hp. boiler carrying a pressure of not less than 100 lb. will meet the requirements. If the tank car can be placed so that a gravity flow from it can be obtained, no pump will be necessary to load the material. A pump is required in the ma-

(Continued on Page 60)

Bituminous Macadam and Bituminous Concrete Pavement Construction—III*

Necessity of Proper Inspection in Bituminous Concrete Construction—Accurate Proportioning a Prime Requisite—Raking Requires Considerable Skill

By E. J. WULFF†

(Concluded from July 27)

INSPECTION IS ONE OF THE VITAL ELEMENTS IN BITUMINOUS CONSTRUCTION where so much depends upon the control of the materials and the methods employed. This phase of bituminous pavement construction—so often neglected in practice—is emphasized in this, the concluding installment of Mr. Wulff's article.

Close and Intelligent Inspection Necessary

It is the function of the plant inspector to control the grading of the mineral aggregate, the heating of the materials, and the process of mixing. The various processes are usually described in considerable detail in most specifications and must be followed closely.

It is unusual that a sand from one source has the grading requirements for the fine aggregate of an asphaltic concrete, and for that reason two sands or even three sands of different mesh compositions must often be combined to obtain the desired grading.

As the physical work of shoveling sand into the heater is usually done by unskilled labor, this part of the work should be placed in charge of a competent foreman so that the sand from various piles may be fed into the heater in the correct proportions. The inspector will take samples from the hot sandbox at frequent intervals and sift the sand to control the grading and keep it within the limiting requirement.

Lack of care in this respect is probably the most prolific cause of early failure and lack of permanency of our asphaltic concrete pavements.

The temperature limits placed on the heating of the mineral aggregate and asphaltic cements have a number of reasons. If we consider first the asphalt cements, we find that the maximum temperature limit for native asphalts is placed at 350° F., for oil asphalts at 250° F. The requirement for a higher temperature for the native asphalts is for the reason that they are somewhat stiffer, at the same temperature, than the oil asphalts. However, if maintained at the higher temperature for prolonged periods or if the temperature be materially increased they harden much more rapidly than oil asphalts. It is, therefore, essential that the maximum temperature for the native asphalts be not exceeded. The oil asphalts are sufficiently fluid at the lower temperatures but an increase in temperature is not so detrimental. However, if a higher temperature is used it delays the rolling after the material is placed in the road as it must cool off sufficiently before effective rolling can be commenced.

With reference to the heating of the mineral aggregate, the same reasons apply both as to the workability of the mix in the mixer and rolling on the road. Overheating of the stone will have the same detrimental effect on the asphalt as if the asphalt itself had been overheated. Particular care is required where the coarse aggregate is composed of dolomitic limestone. This rock occasionally calcines at comparatively low temperatures that might conceivably have no serious effect if used in connection with an oil asphalt. However, cases have come under the writer's observation in which, after a comparatively short period, the coarse limestone disintegrated and slaked out of the pavement. While such occurrences are rare they will have to be considered.

Accurate Proportioning A Necessity

In combining the materials in the mixer care in weighing the materials is essential, and this applies with particular force to asphaltic cement. Once the amount necessary to coat the mineral aggregate has been determined by computation and final experiment, that amount should be correct for succeeding batches, provided the quality of the mineral aggregate also remains uniform, and it follows that the amount of asphalt should be weighed out carefully for each batch. Even a comparatively small increase or decrease has its detrimental effect and will manifest itself sooner or later, even if no very noticeable differences are apparent during the operation. In order to obtain a well coordinated mixture, the materials should be combined by first mixing the mineral aggregate consisting of the coarse stone, the fine aggregate, and the mineral filler for a number of revolutions until thoroughly mixed before adding the asphaltic cement, after which the mixing should continue long enough to be sure that each particle is thoroughly and uniformly coated. A very useful field test is the so-called stain test in which a small amount of the mixture is compressed in a folded sheet of heavy manila wrapping paper. The resulting stain on the paper is an indication of the amount of asphalt in the mixture. This test while most useful in sheet asphalt is also applicable with some modifications to asphaltic concretes.

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*From "Public Roads," the official publication of the U. S. Bureau of Public Roads, June, 1921.

†Senior Highway Engineer, U. S. Bureau of Public Roads.

It is assumed that the mixing is done in a modern mixing plant designed to separate the screened stone and fine aggregate into separate compartments, whence they are combined by weight into the mixing box in which the combined materials are thoroughly mixed by rapidly revolving blades.

Cases have come under observation where a definite mixture was specified; but the contractor was permitted to use concrete mixers and rough field methods for combining the materials. The results of such methods can only produce uneven mixtures and lack of uniformity. Such pavement can not possibly conform to essential grading requirements and can not, therefore, have the permanency that should be expected.

It is customary and necessary, although frequently omitted, to have a daily sample of the finished mixture tested as to its composition. Such a test should be confirmatory of the predetermined composition of the mixture. This test is in a great many cases the only attempt made at control of the mixture, and if so used, it is of no particular value unless supplemented by intelligent inspection. The sample taken represents a daily output of from 800 to 1,800 sq. yd. of pavement. The report of the test, which under the most favorable conditions takes a number of hours if made at the plant itself and as many days perhaps if made at a testing laboratory at some distance from the work, ordinarily arrives too late to be of much immediate benefit. The plant inspector should be qualified and should have the necessary apparatus to make an extraction of asphalt from the finished mixture and make the sieve analysis of the composition of the sample. Only in such a case has the test any value, as a remedy can then be applied immediately. The subsequent test made at the testing laboratory would in such a case, be a check of the test made at the field laboratory.

It is customery particularly in the construction of country roads to obtain the asphaltic cement ready fluxed and in that case the penetration requirement can be checked a sufficient time in advance of the beginning of operations. In the event that the asphalt and flux are combined at the plant, the laboratory equipment should also include a penetrometer in order that an asphaltic cement of the required penetration may be prepared. The penetrometer is also useful if it is found that the ready-fluxed asphalt cement differs in the penetration from the specification requirement. In such a case the correction can be controlled by the addition of asphalt or flux as the case may be.

The Road Inspector's Functions

The inspection on the road, while of relatively less importance than at the plant, is, however, usually done is some perfunctory manner. Even if the road inspection is competent, it is then too late to correct any serious errors made at the plant. The road inspector's function is primarily to see that the mixture is carefully placed and rolled—an important function, because the manipulation in the road determines very largely the behavior of the pavement under traffic. Of primary importance in placing the pavement is the requirement that the base course shall be clean and free of loose dirt or dust. As no binder course is required in asphaltic concrete the rolling is made difficult when loose dirt or dust favors the so-called shoving or pushing of the hot asphalt mixture under rolling. The presence of such foreign material often leads to checking and cracking of the surface under rolling, particularly in the Topeka types of pavement. When the pavement is to be laid on a broken stone or macadam foudation, it is particularly necessary not only that the stone course shall be consolidated well, but also that all free sand or dust shall be swept off in order that the mixture may come in immediate contact with the stone. Where the foundation is a cement concrete the latter should be slightly rough and if, as happens occasionally, a surface shows excessively shiny or smooth a thin paint coat of asphalt should be applied before placing the hot mixture.

When the mixture is spread, the load should be dumped sufficiently in advance of the face of the material already laid so that it will be necessary to shovel the whole load into position for raking. Only if the material is uniformly loose and of uniform depth is it possible for the rakers to produce a surface that will remain free from lumps due to uneven compression.

In order to have an effective control of the depth of the pavement the inspector should have the necessary information regarding the specific gravity or density of the pavement.

The density varies with different types of mixtures as well as with varying density of the mineral aggregate and asphalt composing the mixture. The theoretical density is proportional to the volumetric percentage of the mineral aggregate and asphalt and their specific gravities. This density, which should be determined by computation and test, ranges from about 2.25 for a sheet asphalt mixture to 2.60 for a coarse-aggregate type of asphaltic concrete, if made of trap rock.

While in practice these theoretical densities are not obtainable absolutely, the actual density should not differ materially from the theoretical; otherwise it is a certain indication of a defective grading and implies generally an excessive porosity. If the mixture is delivered on the road in definite weights, as is customary, it is practicable to assign a definite space for each load, thus insuring uniform depth of

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GOOD ROADS

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ROADS IN MEXICO

If Mexico carries out even a part of the road building program indicated in the article by Major Kingsley, printed on other pages of this issue, she will have taken a long step towards better things.

A nation's highways measure its material prosperity and its culture. Communication is, and has been, difficult in Mexico and the country's political existence has been chaotic. The bulk of the population is ignorant and education is the people's crying need. Good roads bring education, among other benefits, and by building roads the country necessarily puts educational facilities within reach of more of its people, thus providing for a better citizenship in the future.

Past experience has not been such as to engender any great expectation of sufficient stability in Mexican affairs to assure the carrying out of any definite program of betterments—of transportation facilities or anything else. At the same time, there is apparent in some quarters a belief that the present administration is strong enough and sincere enough to at least make a real effort to keep internal peace and order, adjust the nation's somewhat precarious and uncertain relations with other powers and restore the shattered fabric of its business and social life. If this belief is justified—and the determination to look to the improvement of the highways augurs well—Mexico may yet take the place in the world that she is entitled to by her resources and her opportunities.

HUMAN RELATIONS IN ROAD BUILDING ORGANIZATIONS

Of all the multitudinous problems of highway organization and administration, probably the most neglected—certainly the most vital—is that of the proper adjustment of human relations.

Morale, cooperation and loyalty depend upon it and without those three essentials no organization can long function efficiently, no administration long succeed.

Scientific division of duties and responsibilities, systematic and well ordered routine, complete and well arranged records, proper personnel—even enough of the right kind of mechanical equipment—are of great value and, indeed, are necessary to the attainment of the maximum efficiency. But they are all of little avail unless the organization is permeated by the right spirit. Individual excellence is a factor that can not be ignored, but it is not a determining factor. A force of individuals of only mediocre ability under an able chief with an understanding of human nature and an appreciation of the human side of his job is infinitely more effective than a staff of individuals of extraordinary ability under a head quite as competent as the other but without the other's human qualities.

In spite of the shortcomings of organizations built up of political appointees, the results of loyal cooperation are often to be observed in them. The reason is plain, for the very quality that makes a man a successful politician is his ability and readiness to "be human" under all circumstances and at all times.

And it is to this condition that we owe such efficiency as found in the various political departments, bureaus, commissions and the like that carry on the public's business.

More than a few noteworthy examples of the leavening effect of a live human being instead of a coldly efficient supervisory machine at the head of things are found in contractors' organizations. Find a successful, progressive concern—in the contracting or any other field—and you find one in which the employees, from the bottom up, are imbued with the spirit of "My country right or wrong." And if a close examination is possible, it will reveal somewhere near the top of the organization a man who would scorn the usual cant about the "brotherhood of man," but who unconsciously—or subconsciously—recognizes and acts upon the fact that the rest of the organization is composed entirely of other men with hopes and ambitions, virtues and faults, strengths and weaknesses, just like his own.

Contractors' Plants for Asphalt Paving Jobs

(Continued from Page 56)

jority of cases, however, and a duplex steam pump of a capacity of 50 to 60 gal. per minute is sufficiently large.

A tank car can be heated much more rapidly if the asphalt is kept circulating, which may be accomplished by continually pumping the asphalt from the bottom of the car around through the pipes to the top. A proper arrangement of valves and pipes will allow this to be done. A typical arrangement for piping to a tank car is shown in Fig. 2. Temperatures sufficiently high for properly applying the asphalt may be obtained by heating the tank cars in such manner. It is possible to raise the temperature of the asphalt by superheating the steam, or by pumping the asphalt through a short coil of pipe laid on a coal fire, the coil being placed in the line between the pump and the delivery end to the tanks in which the asphalt is to be hauled away. Many of the distributing trucks and tanks used on penetration jobs are equipped to load themselves from tank cars. This is usually accomplished by a pump on the truck, by creating a vacuum in the receiving tank, or by applying either steam or air pressure to the top of the tank car, forcing the material over.

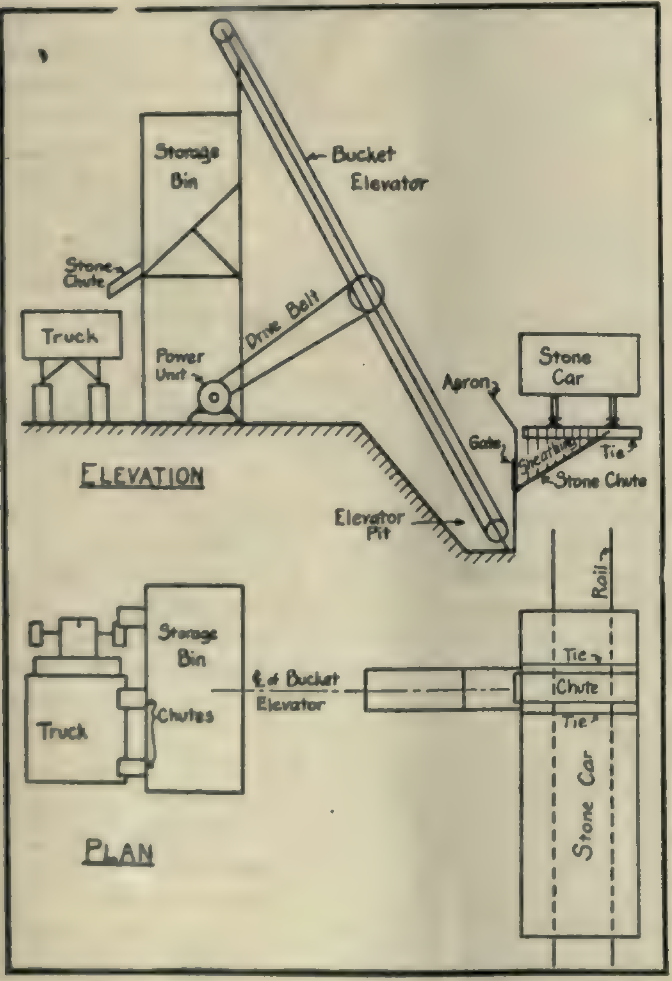

FIG. 1

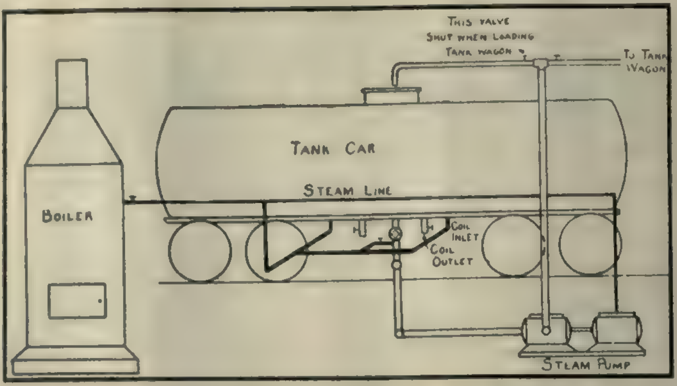

FIG. 2

Trying to heat asphalt in a tank car with a broken or leaky coil is an expensive and vexing problem for the contractor. If the coil does not leak too badly, the material may be heated hot enough to pump from the car, and then brought to the temperature at which it is to be used by some means outside of the tank car. Where the coil is in such bad shape that much foaming will occur before the material gets warm enough to pump, the coil in the car will have to be abandoned and small coils will have to be inserted in the car through the manhole.

Demurrage on tank cars counts up rapidly after the car is held beyond the free time. On penetration work, a tank can be unloaded usually in from one to two days after the material is hot, so that a tank should not be held for any length of time if the work is properly planned and the weather is favorable for application of the asphalt. When tank car shipments are used in connection with a mixing plant, the time of unloading will be somewhat longer, possibly from four days to a week. There is this difference between penetration work and hot mix work, however, that must be appreciated. In penetration work, where the traffic can be kept off the road, long stretches of road can be prepared in anticipation of the asphalt and when the asphalt arrives the road surface can be rapidly made up and practically no lost time is involved. Serious delays will occur in hot mix work due to lack of asphalt. The mixing plant is idle and no progress at all can be made on the finished surface. To provide against such a contingency it is often advisable in hot mix work to build storage tanks that will have a capacity of one or more tank cars so that a reserve supply of asphalt may always be had. If a storage tank is provided, the tank car can be unloaded without delay. Steel shells of a size sufficient to accomodate a tank car are expensive and cumbersome to move and erect unless a permanent set-up is to be had. In connection with the work of portable mixing plants, concrete tanks may be constructed below the ground level and abandoned when the job is done. Such tanks can be constructed of the desired size and equipped with the necessary steam coils and roofed to keep out the water, at a nominal cost. The asphalt is heated in the tank car and allowed to run by gravity into the concrete tank from which it is pumped, as required, to the mixing plant.

Barrel and drum shipments are heated in kettles. In either penetration or hot mix work it is important to have a kettle capacity large enough for the needs of the work, in order to make proper progress and decrease the cost. For a portable kettle on penetration work, the writer would not recommend a size smaller than 500 gal. capacity, and three such kettles would be required for the usual job. Two 1,250-gal. kettles are sufficiently large to supply a 1,000-sq. yd. mixing plant. If cold material is fed gradually to a kettle as it is being emptied, a new charge will be hot in much quicker time than if reloading the kettle is not started until it is practically empty. Kettles should be regularly and thoroughly cleaned, the interval of cleaning depending somewhat upon the asphalt used. Asphalt will form layers of coke upon the bottom of the kettle, which not only retards the heating greatly, but also ruins the kettle bottom if not removed, by allowing it to burn through.

(To be continued)

Highway Engineering Courses*

Conclusions Relative to the Character of Training Needed in Colleges and Engineering Schools

1. In four-year civil engineering curricula without technical electives, there should be included a course in the fundamentals of highway engineering, aggregating three hours per week throughout one collegiate year.

2. In four-year civil engineering courses with options, there should be included a two or three hour semester course, or a course aggregating 30 to 50 hours, in the fundamentals of highway engineering, and optional courses aggregating 6 to 9 hours a week for one semester, which would include courses in the theory and economics of highway improvements, highway design and highway laboratory.

3. In not less than ten universities, located in different geographical sections of the United States, there should be offered short period advanced courses covering all phases of highway engineering. These advanced specialized courses should be designed primarily for men who have taken a first degree, who have acquired a knowledge of the fundamental principles upon which such advanced courses are based, and who have had a certain amount of experience in highway engineering. It is evident that such courses should be given under such conditions that it will be practicable for engineers and others engaged in highway engineering to take advantage of the opportunities offered. Such courses, given in a concentrated form in short periods of from two to three weeks during the winter months, constitute the most efficient method of meeting the demand of practicing engineers for advanced technical education in highway engineering. Graduate courses of this type are fully explained in a paper entitled "Graduate Courses for Practicing Engineers," presented before the Society in 1916.

4. One engineering institution in each state should conduct, some time during the winter months, a highway engineering conference, of about one week in length, for the discussion of the highway engineering problems of the state by the engineers and officials of the state, county and municipal highway departments.

Bureau of Public Roads Will Conduct Nation-Wide Highway Survey

The U. S. Bureau of Public Roads has started recently a highway survey which will study road matters in both rural and urban territories, thus differing from former surveys, which concerned themselves solely with rural highways. Road mileages, expenditures, sources of revenue, amounts of various types of pavements and other data will be collected. With these facts, the bureau hopes to be better able to understand the economics of highway work in this country. With road expenditures rapidly approaching one billion dollars annually, it is necessary that accurate information be secured to guide communities in spending their money efficiently and economically.

Pennsylvania Plans Wider Highways

Building Lines Established on Main Roads Leading Into Cities

At the last session of the Pennsylvania Legislature a law was passed permitting the State Highway Department to widen important roads in the state when necessary.

For the past two years the department has been studying traffic conditions on roads leading to important municipalities and eventually steps will be taken to increase the widths of arteries leading into the larger cities. While no immediate construction is planned, "The department is making surveys of possible future traffic so that lines may be laid down for the guidance of individuals or others who are contemplating improvements along these routes. The proceeding is similar to that followed by municipalities which establish building lines along undeveloped streets."

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*Conclusions contained in the 1921 report of the Committee on Civil Engineering of the Society for the Promotion of Engineering Education.

Presented by the chairman, Arthur H. Blanchard, Professor of Highway Engineering and Highway Transport, University of Michigan, at the annual meeting of the Society at New Haven, Conn., June 28,1921.

Mexico to Undertake Extensive Road Building Program

American Delegation from Southwest Recently Completed Tour to Mexico City, Holding Conferences on the Way to Consider International Highway Routes and Other Road Matters

By E. A. KINGSLEY*

Early this year D. E. Colp of San Antonio, Texas, and Fred W. Mally of Laredo, Texas, both officials of the Meridian Highway Association, with the cooperation of officials of the Department of Communications and Public Works of Mexico, began a campaign to extend the Meridian Highway from the Rio Grande to Mexico City.

Unlike many paper roads, the Meridian Highway through the United States has become an actual fact. The road begins at Laredo on the Rio Grande and extends northward through Texas and the states north of Texas to Winnipeg, Canada. Through three-fourths of Texas it is either a paved highway or one on which paving is under construction. In Oklahoma bridges over the Canadian River have been built or are under way, and the bridge crossing the Missouri River in South Dakota is now under construction. Much of the road north of Texas has been graveled or paved and all has been graded. The highway has been "signed" for the entire distance and, with the completion of the work being done this year, and the bridges, the road will be open for traffic for the entire distance through the United States.

With the induction into office of the Obregon administration, came the first real efforts in Mexico towards rehabilitation on a peace basis. The Department of Commerce and Communication established in Mexico City a well officered and well organized highway department. This department has started a movement to enlist the state governments, and to cooperate with them, in a general road construction campaign.

In conjunction with the Meridian Highway party, the first of a series of joint conferences with Mexico has just been completed. At the invitation of the Mexican Government, a party of 14 citizens of the United States crossed the Rio Grande on May 12, en route to Mexico City. The delegation was headed by D. E. Colp, Vice President of the Meridian Highway Association, and Fred W. Mally, Secretary of the Laredo Chamber of Commerce. Others were: G. A. MacHaughton, Texas Secretary of the Meridian Highway Association; R. M. Hubbard, W. W. McCrory and D. K. Martin, composing the Texas State Highway Commission; Sam Mackin, President of the Laredo Chamber of Commerce; H. C. Odle, of Texas; F. L. Patten and F. J. Gentry, of Oklahoma; Dr. F. A. Long, of Nebraska; W. M. Shirley, of South Dakota; Ben Baines; and the writer as engineer for the party.

The Mexican Secretary of Commerce and Communications delegated two of his engineers, Senores Jorge Nunez and Pablo Phillipi, and the War Department assigned as a guard of honor Col. E. M. Cirlos and Maj. G. Moreno to meet the party and escort it. The army Pullman "Juarez" was assigned to the use of the party from the border to Mexico City and return.

Beginning with a meeting at Monterey with Governor Juan M. Garcia of the State of Neuvo Leon on June 13, a series of four conferences was held to learn of conditions surrounding road matters in the various states.

The second conference was held with Governor Gutierrez of the State of Coahuilla at Saltillo on the 14th. On June 16 the third was held with Governor Nieto of the State of San Luis Potosi at San Luis Potosi and the fourth was held with Governor Jose M. Truchuelo of the State of Queratario at Queratario.

Engineer Jose F. Montesinos of Victoria, State of Tamaulipas, joined the conference at Monterey. He had been delegated by Governor De Lara to represent Tamaulipas, the party being unable to visit Victoria because of the time required for the trip. Ex-President Ferrara also joined that conference.

At El Salado, between Saltillo and San Luis Potosi, a delegation from the City of Matchuala boarded the car Juarez and rode with the party to Vanegas where another delegation from the same city was found. A conference of about thirty minutes was held at the station with these enthusiastic citizens.

On arrival in Mexico City, on the morning of the 18th, the party was met by a reception committee from Secretary Faustino Roel of the Department of Communications and Public Works. An extended meeting was held with the secretary during the day and the results of the various five-day conferences were outlined to him in detail.

He then outlined his plan for the cooperation of the Mexican National Government with the various state governments in planning and building a system of interstate highways that would link into the United States highways at Laredo, Brownsville and El Paso. In other words, the secretary's plans are for an international highway from Mexico City to the north and east of the United States. The secretary expressed himself as highly pleased at the reports from the various states and gratified over the results of the various conferences. He assured the delegation that the Mexican Government was aroused and thoroughly in earnest regarding the development of a system of national highways so connecting as to secure in the immediate future at least one international highway.

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*Consulting Highway Engineer, Little Rock, Ark.

Arkansas is especially interested in the first international highway proposed. Most people of the United States know but one city of the Southern Republic, the City of Mexico. The majority of the educated citizens of Mexico know three cities of the United States—San Antonio, Texas, Washington and New York. The first of their international highways, therefore, will be through San Antonio towards Washington and New York. This plan quickly developed itself at Secretary Roel's conference.

The various Mexican highways planned lead from or towards Mexico City. But their Texas border connections lead through Brownsville or Laredo to San Antonio. From San Antonio northward the Meridian Highway traverses Texas and leads northward through Oklahoma to Winnipeg, Canada. But at Waco and at Dallas the east lines desired by Mexico, branch off, converging at Texarkana, and pass through Arkansas. One line from Little Rock will lead to St. Louis and the north and east. The other line will pass east through Memphis. Little Rock will be an important station on the line and whichever route from Little Rock is chosen for travel, the entire State of Arkansas will be traversed.

The wonderful climate of the Southern Republic, its scenic beauty and its relics of a glorious past will make Mexico a tourists' paradise. Saltillo, an educational center; Queretaro, the ancient city and last resort of the ill-fated Maximilian; the wonderful city of Mexico and hundreds of other places of interest make the country a never ending change of scene. Two things are essential, good roads and permanent peace. Permanent peace can more speedily be had by obtaining recognition and thus stabilizing the present government. The construction of roads will facilitate the rapid movement of the rural police and eventually eliminate the bandit curse. All these things are fully realized by the present government.

Much road construction is now being done by the various states and by the national government. Some of this work is of a permanent nature and some graded and graveled roads. All culverts and bridges built are of permanent types. Grades and road widths are all planned for the future and for ultimate permanent work. The Mexican highway engineers are men of much ability and are doing partially educated) in colleges of the United States. excellent work. Many of them were educated (or Senor Nunez, one of the delegation hosts, is a graduate of the University of Pennsylvania.

On the 19th the party was taken in automobiles to Cuernavaca in the State of Morelos. This trip of 45 mi. was made across the mountains and down into the quaint old tropical city, the original capital of Cortez, the Spanish Conqueror. Of late years Morelos has been the state of Zapata, the great bandit chieftain. A new road has almost been completed by the National Government, but an atmosphere of peace and industry prevail everywhere. Much evidence of warfare and consequent destruction are everywhere apparent but reconstruction is being carried on with great rapidity. Farms are under cultivation and various industries are in operation or are being rebuilt.

On the 20th a number of more recently built roads were gone over and some considerable work under construction was shown. Progress and peace were evident everywhere.

The personal interest of President Obregon was shown by an audience granted to the delegation on the afternoon of the 20th. After a trip over the famous old Chapultepec in company with Secretary Roel, the entire party was presented to President Obregon. He expressed his appreciation of the efforts made by the delegation to enlist the various states in the international highway project and pledged the National Government's cooperation to the fullest possible extent. Apparently President Obregon realizes fully what a system of national and international highways means to his country.

Some striking features were brought home to each member of the delegation. The apparent attempt to the people to rebuild and overcome the results of so many years of warfare was most in evidence. Building and rebuilding is going on everywhere. At San Luis Potosi, for example, several million dollars are being spent for buildings and machinery of the most modern type to make a rough cloth from cactus fibre. The plant is electrically operated, the current being generated by water power far away in the mountains.

Evidences were plentiful on every hand of a change in educational methods. Free public schools are being installed and education made compulsory. At Saltillo a visit was made to one of the schools and the work was shown from the kindergarten to the normal school. This school work, more than anything else, means a new Mexico in the next generation. As was expressed amongst the visitors, such training as the children are now receiving means for the next generation, not a host of Mexicans but host of Mexican citizens.

Another welcome surprise was the entire absence of the oft mentioned "bitter animosity" towards citizens of the United States. Not only was there not the least trace of animosity, but a feeling of cordiality was everywhere apparent. In fact there was on every hand an apparently sincere desire for closer and more friendly relations with the United States. The people seem to want to trade with our people and to learn more about us.

The President is an earnest man with a strong but jovial countenance. He seems to be laboring hard for a new Mexico. After more than ten years of warfare, his work is no light effort. His country cannot be rebuilt in a day nor can he rebuild it alone. The President, too, and his officials are terribly in earnest about perfecting a road program. It is not, with them, a question of pleasure highways. It is in the first place a question of dollars and cents. We forget that the Mexicans are Americans as are we of the United States. They realize that good roads will help develop the country, but that first they will draw the United States tourist. And they know what tourist travel means to their country. Then, along with their public schools, roads are educators and ties that bind one state more closely with the adjoining or farther distant state, so becoming an increasing power for pacification and union.

Finally, they believe, as we north of the Rio Grande believe, that international highways will bind Mexico and our own country closer together because of the better acquaintance between the two peoples.

If the Mexican Government shall soon be recognized by the Government at Washington, a long step forward will have been taken in Mexican affairs. The entire delegation was impressed by the ned of recognition and the good that would come to both countries. Mexico is a wonderful country and almost undeveloped. Lasting peace will bring prosperity and progress with better understandings and closer relations with this country. If any one tells you that the intelligent Mexican is not a loyal citizen or is not progressive, put it down that that man does not know what he is talking about. It is the Mexican who is at work now investing his money in factories and industries. And it is this same Mexican who will show you by word and deed how really anxious he is for his big brother republic in the north to be his friend. The intelligent Mexican is really honest and earnest in these endeavors. May the so badly needed recognition soon be given was the prayer of each member of the delegation.

California Sells Highway Bonds

On July 15 the California Highway Finance Board sold $4,878,000 of 5¾% highway bonds at a total premium of $19,550. The bonds were over-subscribed because of the higher interest rate.

Pavements in Texas Cities

Cities and towns of Texas at the beginning of the present year had a total of 15,281,173 sq. yd. of hard-surfaced streets. Of this amount 4,827,006 sq. yd. is bitulithic, 2,788,825 sq. yd. vitrified brick, 1,760,137 sq. yd. asphaltic concrete and 1,234,202 sq. yd. Uvalde rock asphalt. The six cities with largest yardages are, Dallas with 2,135,403 sq. yd.; Fort Worth, 1,708,047 sq. yd.; El Paso, 1,699,528 sq. yd.; San Antonio, 1,642,296 sq. yd.; Houston, 1,398,104 sq. yd., and Galveston, 566,834 sq. yd.

New Kansas Automobile Law

Passenger Automobiles Taxed in Proportion to Weight and Trucks in Proportion to Carrying Capacity

The new licensing law of Kansas, which went into effect on July 1, taxes passenger automobiles in proportion to their gross weight above a minimum of 1 ton and assesses motor trucks upon the basis of carrying capacity.

The license fees under the new law are as follows:

Motorcycles, $5.

Passenger automobiles, a minimum fee of $8 with a charge of 50 cents additional for each 100 lb. gross weight in excess of 2,000 lb.

Motor trucks: Capacity, 1 ton or less, $15; over 1 ton and less than 1½ tons, $22.50; over 1½ tons and not over 2 tons, $30; over 2 tons and not over 2½ tons, $37.50; over 2½ tons and not over 3 tons, $45; over 3 tons and not over 4 tons, $70; over 4 tons and not over 5 tons, $100; over 5 tons, $25 for each ton or fraction of a ton of rated carrying capacity.

Electrically propelled motor vehicles, $10.

St. Johns River Bridge Completed

Immense Steel Structure Built at Jacesonville, Fla.

The new bridge over the St. Johns River, Florida, connecting Jacksonville with South Jacksonville, has been completed.

The total length of the structure is 3,925 ft., including approaches. The north approach is 500 ft. long and is built of reinforced concrete. The south approach , 1,050 ft. in length, consists of a sand filled embankment. The bridge proper is of steel, consisting of five 178-ft. deck truss spans, two 136-ft truss spans and one 188-ft. lift span over the deeper part of the river, with seven 100-ft and four 71-ft. deck girder spans over the shallower part of the river. The crown of the roadway over the main channel is 65 ft. above the water, thus permitting smaller boats to pass without using the lift span.

The lift span rises vertically between two towers and has two 700,000-lb. counter-weights suspended by steel ropes passing over cast steel sheaves 12 ft. in diameter. The lift span is operated by electricity.

The bridge was constructed by the Bethlehem Steel Bridge Co.; the approaches and piers were built by the Missouri Valley Bridge & Iron Co. Harrington, Howard & Ash, of Kansas City, Mo., were engineers for the work, with E. R. Needles as resident engineer.

The Road Commissioners of Allegheny County, Pennsylvania, have authorized a bond issue of $880,000. Of this amount, $503,000 will be used for payments on contracts already let.

Bituminous Macadam and Bituminous Concrete Pavement Construction

(Continued from Page 58)

pavement when ultimate compression has been obtained.

Raking Requires Considerable Skill

Raking is work requiring considerable skill, and the function of the inspector is principally to control the depth of the pavement and the correction of defects that may occur under the subsequent rolling. The latter are principally checking (i. e. the opening of fine cracks), irregularity of compression, and irregularity of surface at points. These defects can ordinarily be remedied if attended to immediately. If hair cracks occur, which are usually due to creeping of the soft mixture on loose materials under rolling, loosening and reraking will ordinarily be sufficient. In more severe cases the defective portion must be cut out and replaced after removing the responsible foundation defect.

The rolling of a Topeka type of pavement requires a tandem roller, and the rolling should be commenced as soon as it is practicable to do so. If the material is too hot when placed in the road there is too much delay, aside from possible defects due to burning; if too cold, the necessary compression and the maximum density can not be obtained. If the latter is obtained subsequently under road traffic it is at the expense of uniformity of surface.

After the first rolling, which is generally parallel to the axis of the road, the second rolling is diagonal on the more narrow country roads and cross rolling on city streets. This has the effect of ironing out ridges formed during the first rolling; it also introduces a kneading action necessary to produce the interlocking of the coarse aggregate. After the cross rolling and after all surface corrections have been made Portland cement is swept over the surface and the rolling continued. It should be pointed out here that the surface finish depends entirely upon rolling, also that one roller will only roll satisfactorily not much over 1,000 sq. yd. of surface. If the plant capacity exceeds that amount per day, as is frequently the case, at least two rollers should be employed. Even where the smaller amount is laid each day a second but smaller roller, would be of advantage, as the first rolling can be done somewhat sooner than if only one heavy roller is employed.

The requirement for efficient rolling is not enforced in many cases, and the requirement might reasonably be made plainer in many specifications.

Reference is made above to the sweeping of Portland cement over the pavement while it is still warm and pliable. The principal purpose of the cement is to fill the fine superficial pores, and it is taken up to a limited extent by the asphalt. It takes the place of what was called a seal coat in the old Topeka type before it was modified in its finer aggregate.

The seal coat in the now obsolete Topeka specifications as well as the still valid specifications for some coarse-aggregate asphaltic concretes served a twofold purpose.

In both these mixtures the grading requirements of the fine aggregate, even if properly enforced, could only produce porous mixtures. The seal coat consisted of a squeegee application of fluid asphalt cement that penetrated to some slight depth into the surface mixture and provided at least a temporary waterproofing. The seal coat with the following covering of stone chips also filled the superficial pores caused by the depression of the coarse stone into wearing surface.

A seal coat is still employed in the coarse-aggregate types and is required for the reason that the superficial pores are of much greater extent than in the Topeka type. As the coarse aggregate is much larger and constitutes nearly two-thirds of the entire mass of the pavement it follows that, in rolling, the larger stone, being depressed into the mass, will leave surface pores of comparatively large size. The only object of the seal coat at the present time is to fill these pores. While a thin coat of fluid asphalt covered with stone chips is frequently employed, a more rational seal coat consists of a thin coating of a mixture of fine aggregate and asphalt, as required in the body of the asphaltic concrete—in substance a sheet-asphalt mixture. This is thinly spread and raked over the pavement after the first rolling and after the surface corrections have been made and then rolled into surface. The final finish for this pavement, as well as the other types, is Portland cement or limestone dust.

What has been said about field operations and inspection heretofore applies with equal force to the coarse-aggregate types. The latter can be made, the same as the small aggregate types, a pavement of permanent value, not by lucky accident, as has been the case many times in the past, but by design and conscientious insistence on the observance of essential requirements.

THE END.

Beet Juice Injures Pavements

Because drippings from beet wagons passing over the streets of Fort Collins, Colo., injured the concrete pavements, an ordinance has been passed by that city prohibiting the transportation of beet pulp unless carried in water-tight wagons.

Pennsylvania Will Build Forest Roads

The Pennsylvania State Forestry Department plans to construct 167 mi. of forest roads and 227 mi. of trail during the next 12 months, according to Maj. Robert Y. Stuart, Deputy Forestry Commissioner. This work involves 46 projects in 11 forests.

MEETINGS

Calendar of Coming Meetings

Aug. 30-Sept. 1—Michigan State Good Roads Association.—Annual meeting, Flint, Mich. P. T. Colgrove, Pres., Hastings, Mich.

Oct. 24-28—American Society for Municipal Improvements—Annual Convention, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Dixie Highway Association

The annual convention of the Dixie Highway Association will be held on Sept. 9 and 10 at Cincinnati, O. It is planned to have two automobile caravans, one starting at Mackinaw, Mich., and the other at Miami, Fla., the two extremities of the Dixie Highway, travel over this highway so as to arrive in Cincinnati on the evening of Sept. 8. Delegates will join the caravans at various points.

PERSONAL MENTION

J. C. Gardner has been appointed city engineer of Niagara Falls, Ont.

W. W. McClendon has resigned as city engineer of Mineral Springs, Tex.

Nelson P. Whitaker has been appointed a member of the West Virginia State Road Commission.

Burton Hamilton, formerly Assistant City Engineer, has been appointed city engineer of Alameda, Cal.

Charles Chappel, formerly County Engineer of Navarro County, Texas, has been appointed county engineer of Camp County, Texas.

Ray Speer has resigned as county engineer of Keweenaw County, Michigan, and is now with the Wisconsin State Highway Department.

G. E. Parker has been appointed junior assistant engineer by the New York State Highway Department, with headquarters at Watertown.

Howard E. Whitney has been appointed junior assistant engineer by the New York State Highway Department, with headquarters at Watertown.

J. P. Blunden, formerly County Engineer of Boone County, West Virginia, has been appointed assistant division engineer by the West Virginia State Highway Department, with headquarters at Martinsburg.

OBITUARY

Adolpho Oliveras, a road contractor who built many of the highways in the Palisades District of Santa Monica, died in Santa Monica, Cal., on July 3.

R. H. Gillespie, President of the Traylor-Dewey Contracting Co., Allentown, Pa., died on July 15 at White Lake, N. Y. Mr. Gillespie was graduated from Union College, Schenectady, N. Y., and from 1888 to 1894 was engaged in railroad work. In 1896 he became assistant engineer in the Department of Street Improvements of the 23rd and 24th Wards of New York City and for about 12 years was chief engineer of sewers and highways, Borough of Bronx, New York City.

Several Bridges on the North Platte River in Nebraska were recently washed out by floods.

Pickens County, Alabama, has voted a road bond issue of $200,000. An equal amount of state and federal funds will become available to the county.

The Virginia State Highway Commission during May and June awarded contracts totaling $1,209,000 for road and bridge construction. These contracts provide for 102 mi. of highways.

Burlington County, New Jersey has filed a claim for $400,000 against the Federal Government, alleging that army trucks attached to Camp Dix damaged the roads of the county.

Fulton County, Georgia, plans to spend over $1,000,000 on road and bridge work. Nearly 500 convicts, 54 guards, 112 teamsters with 282 mules, and 30 foremen, blacksmiths, etc., will be engaged in the work.

The New Jersey Bridge and Tunnel Commission will break ground on Aug. 3 at Jersey City for the vehicular tunnel which will connect New York City and Jersey City. Ground was broken for the tunnel on the New York side last October.

Farmers near Auburn, Neb., recently showed how practical is their interest in good roads by getting out and improving four roads having a total length of 15 mi. The county authorities furnished the machinery required and also the tractor and grader operators. According to those who have been over the roads, the work was well done.

66a

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE
WITH WHICH IS INCORPORATED
THE HIGHWAY CONTRACTOR AND ROAD BUILDER

Vol. LXI. NEW YORK, N. Y., AUGUST 10, 1921 Number 6

Modern Highways Will Complete the Reclamation of an Arizona Desert

The Building of 300 Miles of Concrete Highways at the Rate of More than 3,000 Feet a Day Will Complete the Work of Changing Maricopa County, Arizona, from an Arid Waste into a Modern "Garden of Eden"

More than half a mile of completed concrete roadway is being laid every day in carrying out the biggest road contract in history. Last year Maricopa County, Arizona, let the contract for the construction of approximately 140 mi. of concrete highway to Twohy Bros. Co., of Seattle, Wash., at unit prices involving an expenditure of approximately $4,000,000. The contractor was placed under a $1,000,000 bond to complete the contract within two years from May 1, 1920. Because of difficulties of securing equipment, due largely to railroad congestion, actual concreting did not start until Nov. 12 of last year. Thus the contractor is confronted with the task of completing the contract in about one and one-half years. To accomplish this the contractor must lay very nearly one-half a mile of concrete every working day and this is being done.

NIGHT AND DAY SHIFTS are being employed in the effort to complete within the specified time the largest road contract ever awarded—the construction of nearly one hundred and fifty miles of concrete pavements in Maricopa County, Arizona.

THE FAMOUS ROOSEVELT DAM made possible the irrigation of the Salt River Valley, transforming the country from an arid waste to a fertile and productive farming section.

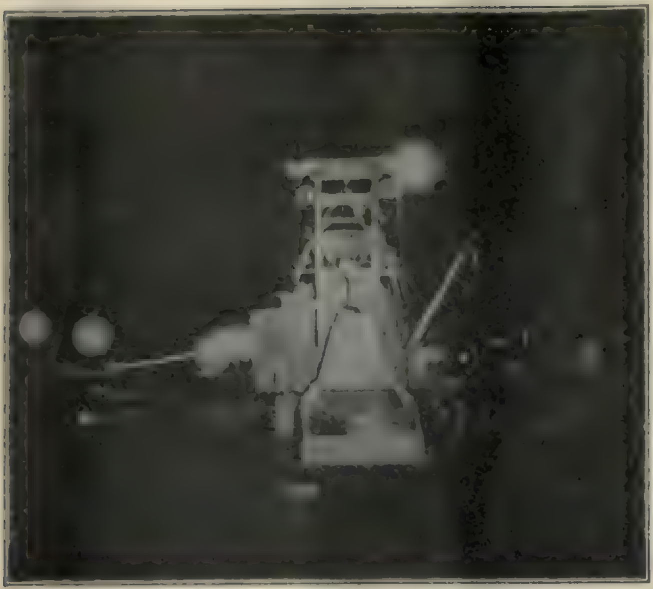
THE COUNTY ROAD SYSTEM, when completed, will connect Phoenix, the county seat and state capital, with a number of other thriving municipalities and bring a paved road within a mile of every farm in the valley section of the county.

THE CONTRACTOR'S PLANT being used to carry on the work is probably the most complete and up-to-date outfit of the kind ever assembled. By its use the builders are putting down more than a half mile of finished pavement every working day.

The county in May, 1919, voted a $4,000,000 bond issue to build a county system of highways embracing 283 mi. The vote cast was 90% affirmative. Subsequently another bond issue of $4,500,000 was voted by the county, as it was found that because of the increased cost of road construction the first bond issue would be inadequate to carry out the program. Because of the conditions prevailing at the time when the first bids were received, in January, 1920, considerable difficulty was experienced "in attracting contractors capable and able financially to undertake the construction of the highways," according to E. Hackett, Chairman of the Maricopa County Highway Commission.

"We received bids for the construction of our roads on Jan. 12, 1920, resulting in all bids being rejected; on March 6 we again received bids, rejecting the same. On April 23 we again received bids and awarded a contract to Twohy Bros. Co., of Seattle, Wash., for the construction of $4,000,000 worth of roads with cement concrete. The contract price for completed roadway," continues Mr. Hackett, "including culverts, guard rails and shoulders 4 ft. wide, are shown as follows: 18 ft. wide, 6 in. thick, $31,404.16, 5 in. thick, $28,054.06; 16 ft. wide, 6 in. thick, $28,290.86, 5 in. thick, $25,326.12 per mile. The commission reserved the right to designate the width and thickness of construction as the work progresses."

At one time Maricopa County was largely a barren waste but is now rendered fertile by irrigation made possible by the Roosevelt Dam. This proposed highway system, now fast being realized,



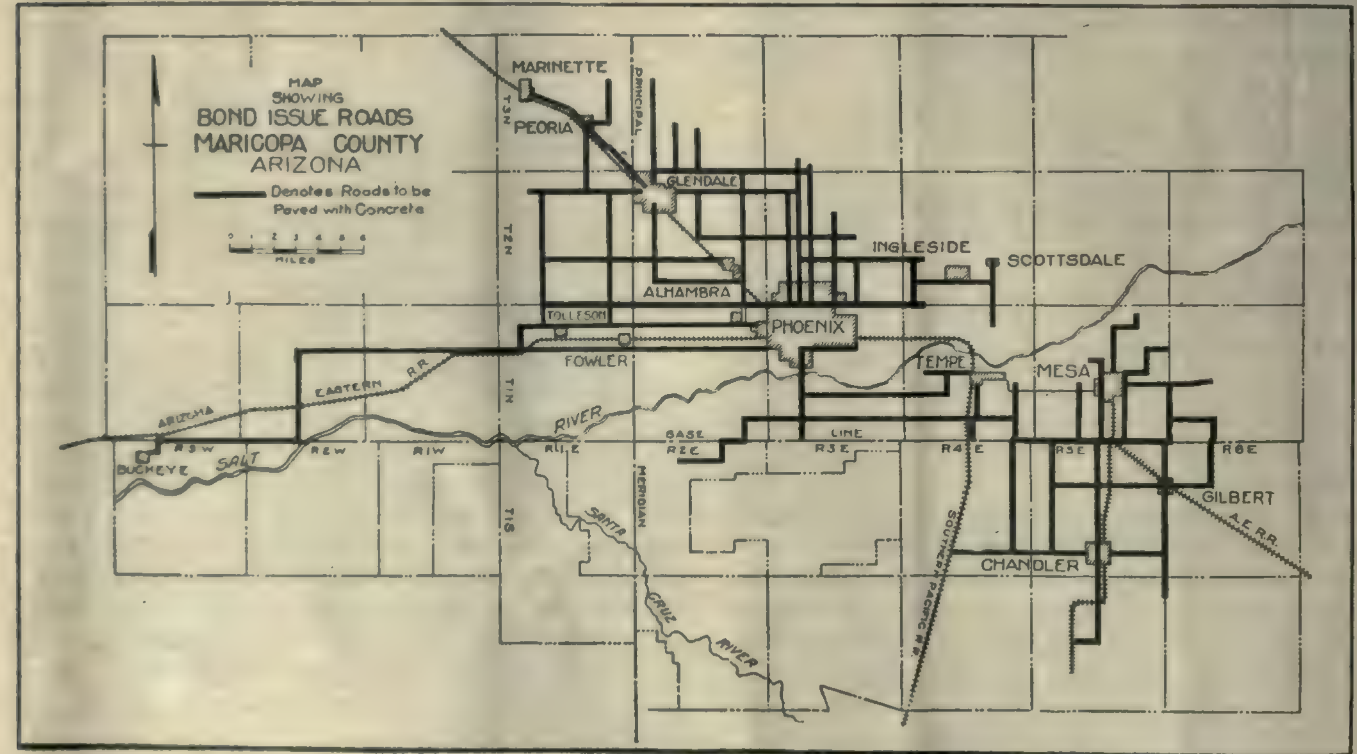
NIGHT SHIFT AT WORK ON THE PAVING OF THE MARICOPA COUNTY ROADS.

will place a paved road within a mile of every farm in the Salt River Valley section of the county, which comprises most of the county. The main roads will be constructed of greater width and thickness than the feeder roads.

In the case of the 18-ft., 6-in. pavements, the subgrade is finished with a 1-in. crown and 2 ft. from each edge is beveled to make the concrete 9 in. thick at the edges of the pavement. Most of the pavement so far laid is either 18 or 16 ft wide, 6 or 5 in. thick, and with a crown of 1 in.

In laying out the work of construction the district was divided into nine sections, a materials plant to be erected at the center of each section, accessible by rail. A central gravel plant has been erected on the south bank of the Salt River at Tempe and the gravel is hauled on standard gauge cars to the proportioning plants. So far, proportioning plants have been erected in two of the nine sections. These section plants are constructed in units held together by bolts and may be quickly knocked down or assembed. The two set-ups are located at Fowler and Chandler (see map).

Excellent gravel is available in the bed of the Salt River at Tempe where a large gravel washing and screening plant in two complete units is operated. Some of the material contains considerable silt but is free from organic matter. The gravel is excavated by means of a 60-ton steam shovel and hauled to the plant in 4-yd. side dump cars in trains of 8 cars by 18-ton dinkey engines. The gravel is passed through a grizzly which separates stone over 2½ in. in size and these stones are crushed in a gyratory crusher. The material, including the crushed gravel, is hoisted by a 60-ft. bucket elevator to the top of the washing tower where it passes through a rotary washer. When both units are operating at capacity approximately 3,000 cu. yd. of sand and pebbles are produced in 16 hours, two shifts usually being worked. From the rotary washer the gravel is passed down a chute leading to the screens and most of the sand is washed out through a plate punched with ⅝-in. holes, which forms the bottom of the chute. The sand drops vertically through a shaft into another



THE HEAVY LINES SHOW THE HIGHWAYS MARICOPA COUNTY, ARIZONA, WILL BUILD IN THE COMPLETION OF ITS BOND ISSUE SYSTEM.

chute to the end of the screen conveyor, 16 in. in diameter and 20 ft. long, delivering the sand to a belt conveyor which carries the sand over two tracks where it is chuted into cars or into storage. The coarse material passes into rotary screens made of five 4-ft. sections, three being punched with 1-in. and two with 2¾-in. holes. Below each screen is a pebble bin holding 750 cu. yd., which straddles a track so as to empty into gondola cars. In loading a car, two or three traps are opened and the car moved back and forth so as to have the material uniformly graded for the central loading plant. The sand is handled largely by a locomotive crane. The aggregate is shipped by local freights over the Arizona Eastern Railroad to the Chandler and Fowler proportioning plants.

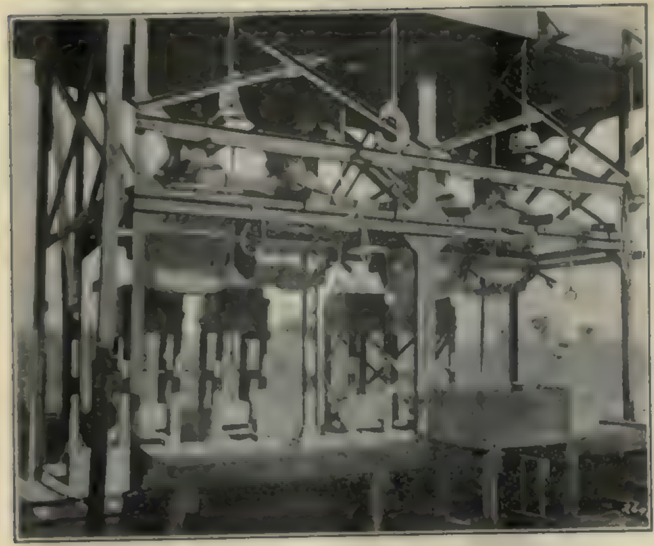
ONE OF THE TWO UNITS OF THE GRAVEL PLANT AT TEMPE—CAPACITY, 3,000 CUBIC YARDS OF AGGREGATE EVERY 24 HOURS.

The proportioning plants are built with long trestles with large storage bins for sand and crushed pebbles on their sides so that the material can be dumped from the standard gauge cars directly into the bins. Six cars are handled at a time by one locomotive, the grade being 4%. The aggregate bins straddle the tracks of the industrial railway and the aggregates are drawn into the industrial cars by traps, it being possible to load 22 batch-boxes with sand and 44 with pebbles without moving the cars. It is planned to increase the length of the sand tunnel on future set-ups to be able to fill 24 batch-boxes, as the trains are composed of 12 cars.

When operations were commenced on the work, cement was shipped in bulk and unloaded by vacuum by means of a Dracco vacuum plant arranged and furnished especially for this job. However, this method did not prove satisfactory because the air locks were ground out by the grit in the cement. In point of economy of cement and dustlessness, however, such a method is satisfactory and would be practical if an efficient air lock were developed. With the use of this vacuum method, the cement was unloaded, weighed on automatic scales and loaded into batch-boxes through canvas chutes.

At the present time cement is shipped in sacks and stored in cement sheds arranged so that a 12-car train can be supplied with cement without spotting cars. Boxes holding four bags of cement each empty into the batch-boxes below by means of chutes. Since there are four of these boxes to every car length, two trains can be loaded before refilling.

From the proportioning plant the aggregates and cement are transported to the mixers by industrial railway. Each car carries two batch-boxes, divided into three compartments for one part of cement, two of sand and four of stone. The cement is loaded first and the cement compartment closed with a metal lid. Then the cars are shunted to the loading tunnels where the sand and rock are loaded. The batch-boxes hold 3,300 lb., and the total load of the 12-car train is about 40 tons. Six-ton Cummings gasoline locomotives are used to haul these trains. The industrial railway equipment being used at the two proportioning plants



AUTOMATIC HOPPER SCALES USED FOR WEIGHING CEMENT AT BEGINNING OF JOB.

comprises 14 mi. of track, 216 cars and 14 locomotives. Tracks are shifted at night to avoid delay in the operations. The maximum haul is 7.5 mi., the sections into which the work was divided being about 15 mi. long. Because the land is very flat and there is but little rainfall, the conditions for the use of industrial railway equipment are excellent.

Although there is but little grading to be done, considerable work is involved in building culverts and bridges for the irrigation ditches. These are constructed usually above the grade of the land and the road passing over one of them must be elevated. After the rough grade is made, Blaw-Knox forms are set in place and a subgrader is run over drawn by a 10-ton roller. The excess earth is used to fill, cover the pavement in curing, and later to make the shoulders.

Each proportioning plant supplies two Lakewood mixers and the work is so laid out that the greatest use can be obtained of the 7.5 mi. of track in each section. The batch-boxes are lifted from the cars as the skip descends. Mixers are run for one minute and emptied into a skip on an 18-ft. boom, with four men engaged in spreading it. Water is readily secured from the numerous irrigation ditches. Tamping and belting machines are used to finish the concrete, the final finish being given by a one-man belting device invented by one of the men employed on the job. The concrete is ponded and is covered by a canvas supported on a frame with wheels running on the forms. Curing is done with 2 in. of soil and 2 in. of water kept on the concrete for 16 days. Each shift places two expansion joints in the roadway.

HAULING AGGREGATES AND CEMENT TO MIXER BY INDUSTRIAL RAILWAY.

Recently a night shift has been inaugurated and by the use of a battery of Carbic lights the work is being satisfactorily done at night. The grading and placing of forms is done during the day and extra trains of materials are loaded by the day crew for use at night. The day shift works from 7 a.m. to 4 p.m., and the night shift from 6 p.m. to 2 a.m.

COMPLETED CONCRETE PAVEMENT PROTECTED FROM SUN BY CANVAS COVER.

A bonus system has been installed so as to coordinate the work and bring about the highest possible efficiency. A bonus of 10% is paid to the men for the completion of every 50 ft. of pavement greater than the footage set as a standard. This has proven a great stimulus for teamwork and as much as 30% bonus has been earned in one day.

The machinery used at the gravel plant is Allis-Chalmers and with the exception of Blaw-Knox forms and Cummings gasoline industrial locomotives, the other equipment is of Lakewood manufacture.

(Concluded on page 76)

Contractors' Plants for Asphalt Paving Jobs—II*

Unloading, Storing and Loading Aggregates—Handling and Heating Asphalt—Mixing Asphaltic Concrete—Hauling—Placing and Spreading

By HENRY B. DROWNE†

(Concluded from August 3)

Mixing Asphaltic Concrete

Mixing plants are of three distinct types, viz., stationary, portable, and railroad plants. All consist of the same units, but arranged differently so as to adapt themselves to the purpose for which the plant is to be used. For highway construction over an extended area, the stationary plant is out of the question, although exceptional instances occur where the mix is hauled for very long distances. Whether a railroad plant or a portable plant is the better proposition for the contractor depends somewhat upon the kind and amount of work he may expect to do. The railroad plant has been designed to prepare sheet asphalt mixtures. Until recently, very little sheet asphalt work has been called for on state highway construction. The investment in a railroad plant is large and the loss on invested capital when the plant is idle should be appreciated. Furthermore, the added cost represented by car frame and trucks must earn depreciation and interest during a possible use of only a few days each season. For state highway construction, it will be found that the portable type is better adapted for the work because the plant can be set on or near the job, thus reducing the hauls on the ingredients used in the mix and on the finished mix. All types are operated in a similar manner and since the writer believes the portable type to be the one that will be most commonly used, he will confine his remarks to that type.

There are several makes of portable plants. The plant consists of four units, viz., the power unit, the kettle unit, the mixing unit and the drying unit. The kettle unit is always separate, and with most makes the power unit is separate. In some the drying and mixing units are also separate. The separation of units is undertaken in order to make the plant more portable. The output of a mixing plant largely depends upon the capacity of the driers. The most sucessful driers are of the rotary cylinder type, so incased by firebrick and metal as to prevent radiation of heat and so designed that the hot gases of combustion are brought into direct contact with the mineral aggregate. Provisions for preventing the aggregate from passing through the cylinder in a mass, and for quickly removing vapor and gasses are essential. A 3-unit plant, having a capacity of 1,250 sq. yd. of 2-in. top in 10 hours, has met all the requirements demanded of it in this kind of work in a very satisfactory manner. In this particular plant the kettle capacity is taken care of by two 12-ton kettles. The power unit consists of a boiler and engine, or, where electric current can be obtained, a 40 hp. motor may be used. The drier and mixer are mounted on a 4-wheeled truck, this unit of the plant weighing about 15 tons. The drier is one of the rotary type, mounted on a large firebox in which coal or oil may be used for fuel. The sand and stone are fed to the drier by means of a bucket elevator and, after passing through the drier, are carried by means of another elevator to the screens through which they pass to the proper compartments of the storage bin. From the storage bin the hot material drops by gravity into the weighing box and from thence into a pug mill mixer. The hot asphalt cement is forced by compressed air through steam jacketed pipes to the asphalt bucket on the mixing platform where it is weighed and discharged into the mixer. The mixing platform is high enough from the ground so that the mix can be dropped through the bottom of the mixing box into wagons or trucks. A typical arrangement of the different units is shown in Fig. 3. While such a plant is more expensive to move and set up than some of the types which are lighter and more portable, the output obtained and the satisfaction with which the work can be done should recommend a plant of this type to the contractor who contemplates doing much hot mix work.

Roughly, in any hot mix work the asphalt comprises only about 10% of the total weight of the mix. The remaining 90% is mineral aggregate which will vary in its requirements, depending upon the type of pavement that is being laid. The proper location of the plant will be governed principally by a consideration of the hauls on the mineral aggregate. Suppose, for example, a paving mixture required the use of stone and sand, the proportions being about 2 of stone to 1 of sand. Assume that stone was imported by railroad and point of delivery was 1 mi. away from the end of a job 1 mi. long, making average haul to job of 1.5 mi. Assume that the sand supply was .5 mi. from the end of the job, makaverage haul of sand 1 mi. to the job, and that the sand was 1.5 mi. from the railroad delivery. Where should the plant be located, from the standpoint of most economical haul?

The amounts of materials making up the mix would be: Stone 60 %, sand 30% and asphalt 10%—or, 70% of the material required for the mix would be delivered at the railroad. For purposes of comparison, assume that 25 ct. per ton-mile would be the cost of hauling either of the raw materials or the finished mix. The following tables show how the cost of hauling per ton might work out:

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*Extracts from "Suggestions for Asphalt Paving Contractors," published by the Asphalt Association, New York, N. Y.

†Division Engineer with the Lane Construction Corporation.

Plant set at railroad:	
Cost of hauling asphalt and stone to plant	0
Cost of hauling sand to plant 1.5 mi., 30% in a ton	11.25
Cost of hauling mix to road 1.5 mi.	37.50
Total per ton	48.75 ct.
Plant set in sand pit:	
Cost of hauling asphalt and stone to plant 1.5 mi., 70% in a ton	26.25
Cost of hauling sand to plant	0
Cost of hauling mix to road 1 mi.	25.00
Total per ton	51.25 ct.
Plant set at end of road:	
Cost of hauling asphalt and stone to plant 1 mi., 70% in a ton	17.50
Cost of hauling sand to plant .5 mi., 30% in a ton	3.75
Cost of hauling mix to road .5 mi.	12.50
Total per ton	33.75 ct.

A comparison made in a similar manner to the foregoing will show in each case how the most economical haul can be obtained where materials are brought in from different points. The expense of set-up and operation should be taken into consideration with the economy of haul before a set-up is determined upon.

Hauling

The method of hauling to adopt depends largely upon the relation between the length of haul and the quantity of material to be moved daily. In excavating, teams are frequently the only means of hauling that can be used, the going is so difficult. If a steam shovel is used and proper footing can be had so that a truck can make headway, dump trucks will be found to be the most economical, particularly if the haul is long. Motor trucks, if they can be loaded quickly and can be kept moving without getting mired, make a very cheap method of hauling. Under these conditions a 5-ton truck will make from 60 to 90 mi. a day. For extremely long hauls the truck is the only method to consider, and in certain instances a truck hauling from a permanent quarry to the job will be far cheaper than taking the stone by rail, unloading it, and hauling it to the job from the nearest railroad point. Hauling stone, bituminous pavement mixtures, bituminous material from central plants to work 30 mi. or more distant is a common occurrence in highway work. The 5-ton truck is the size most commonly used and experience on work seems to warrant this choice.

Where the process of loading is slow and the haul is not too long, the load may be placed in trailers for the truck to haul, the truck itself being used without load. Such a scheme has been used in connection with the delivery of hot pavement mixtures from a portable plant having a capacity of about 1,000 sq. yd. of 2-in. surfacing material a day. The hot mixture was mixed in 500-lb. batches at the rate of a batch every 1½ minutes. Wagons built especially for hot mix work and equipped with short poles were used to receive the mix. Ten batches were dropped in a wagon and two wagon loads, or 5 tons, were considered a load for the truck. While the truck was hauling these wagons to the point where the mixture was being placed, other wagons were being loaded at the plant, awaiting the truck's return. As it would take 30 minutes to load the two wagons, sufficient trucks and wagons were provided, according to the length of haul, so that the plant could mix continuously. On good roads, without grade, the truck could handle the two trailer wagons nicely. The principal advantage of the above method is that fewer trucks are required to do the work than if the mixture is loaded directly into the trucks. One-ton trucks have also been used to advantage in the delivery of hot mix materials on short hauls. For instance, with the mixing plant mentioned above, for an average 1-mi. haul, three 1-ton trucks would be required to take care of the output, against two 5-ton trucks for the same condition. The cost of the three small trucks would be less than that of the two large ones, and, in addition, fewer men would be needed to spread the mix hauled by the small trucks, since the smaller loads could be dumped nearer the point where the mixture was raked out than would be the case with the large loads.

Moving material by means of a train of wagons hauled by a steam roller or steam tractor is the cheapest method of hauling, if the conditions are favorable for it. Steam traction is slow of movement, a speed of 2 to 3 mi. an hour being possible. The fact that loads of from 15 to 30 tons can be drawn offsets this slow speed. The size of the load is governed by the condition of the road surface and the steepness of the grades. For hauls of 1 or 2 mi. in length, and fairly level grades, one roller can sometimes deliver material sufficient for the requirements of the work. Ordinary bottom dump wagons equipped with short poles may be used in the train, but double-ended, reversible hauling wagons, built especially for this kind of work, are more convenient, as the train can be hauled from either end. The double-ended wagons are also arranged to spread the load better than the ordinary dump wagons. If a 3-wheeled roller is used for traction, it will overcome bad conditions of road surface more readily if a split wheel is substituted for the front wheel ordinarily used in rolling. While a steam traction engine is usually more powerful than a roller, it cannot be used except for hauling, and is a piece of plant that is frequently idle if the right hauling condition for its use can not be found.

A traction engine generally does more damage to a road surface over which it travels than a roller, which fact would prohibit its use in some places.

There are many makes of gasoline tractors of all sizes from small to large. In fact, some 3-wheeled rollers are built with a gasoline motor. From the standpoint of general usefulness, the writer believes the steam roller to be far superior to any driven by gasoline motor. The small gasoline tractor, however, may be used for hauling loads in exceptional instances and be worth while. Of the several types with which the writer is familiar, the tractors with the caterpillar tread seem to be best suited for conditions where such machines might be used. A small tractor of this kind will overcome most difficult hauling conditions and an excellent place for its use would be in hauling stone from the nearby fields to the crushers, particularly when the fields were in a wet condition from recent rains.

The same general principles which apply to the economics of hauling other material apply to hauling asphalt. Some asphalt companies have developed a motor truck distributor tank to a high degree of efficiency for use in penetration work. The capacity of the largest tanks is about 1,000 gal. These trucks work from asphalt refineries located near the large centers, and haul to points sometimes 50 mi. away. Such machines are manufactured for sale to the contractor by a number of companies and give excellent results in doing the work. A motor truck distributor, however, is an expensive piece of plant and unless a contractor is sure to have penetration work sufficient to keep it busy, it is not advisable to purchase such an outfit. Certain companies make a tank with distributor attached that may be mounted on a 5-ton dump truck, the dump body being first removed. Such an outfit is better for all around work because, when not putting on asphalt, the dump body can be replaced and the truck used for hauling other material. By mounting a 1,000-gal. tank, equipped with steam coils, on a truck chassis, a cheap method of

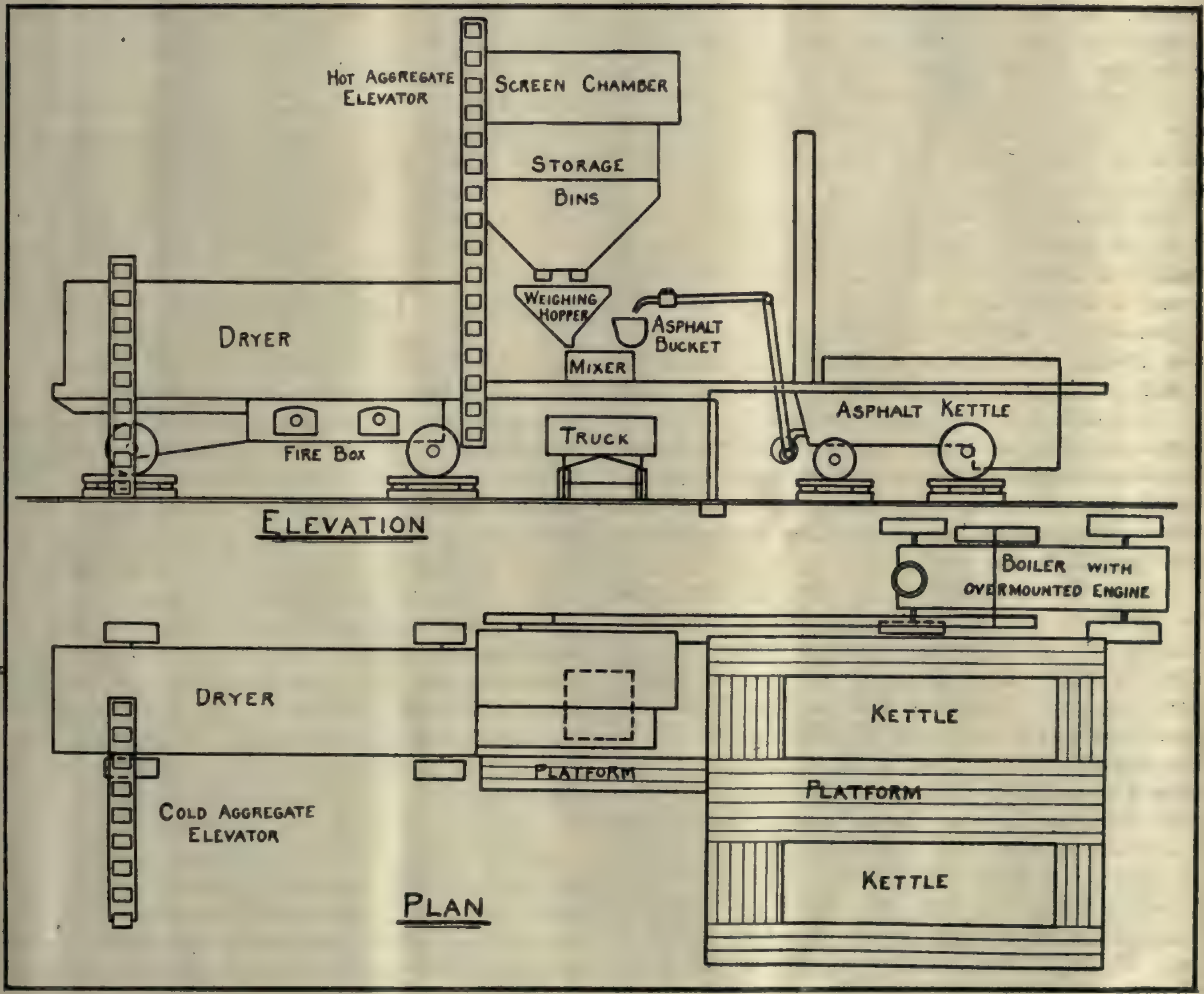

FIG. 3.

(Continued on page 76)

Geological Aspects of Road Construction and Maintenance in the Philippines*

Effects of Climate—Stream Scour and Landslides—Drainage—Maintenance as Affected by Materials—Available Road Stone and Sand

By WARREN D. SMITH †

In parts of the tropics, and particularly in the monsoon region of southeast Asia, the seasons are sharply defined, one of practically no rain and one during which it rains in torrents. If we recall the rule that the carrying power of a stream varies as the sixth power of its velocity, we know at once we cannot take any chances with a tropical torrent. In regions of high relief we have four things to consider, and we cannot neglect any one of them. They are: Declivity or head, sudden increase of volume due to configuration of the valleys, the angle of slope of valley walls, and material and structure of the valley walls.

The writer has seen instances where the highway was placed in a valley at such a point that the road was continually menaced by the stream just below it and by the sliding of material from the slopes above. The stream is dangerous because of two things: First, because of the sapping of the water itself; and second, because, when the velocity is doubled, it can carry particles of rock 64 times as large as before, and in time of freshet bowlders weighing tons are carried along, each one acting as a battering ram. No retaining wall can be expected to withstand this terrific bombardment, nor does it do so.

Again, the composition of the country rock, its structure, texture, and the state of weathering are of vital importance; and, if this weathered material slides into the canyon below, a temporary and very dangerous dam results. When the dam breaks, as it soon must with the impounding of the torrent behind it, all is swept before it. We have a remarkable example of this in the now famous Benguet Road on Luzon Island. Bued River is a small stream, little more than a creek in the dry season. It flows from 1,524 meters, (5,000 ft.) elevation to the sea. The valley walls are V-shaped, the average slope being probably as high as 35 or even 40 deg. The country rock is a badly decomposed andesite, for the most part with some tuff deposits, much jointed and with innumerable small faults, all loosened by many earthquakes. Here we have ideal conditions of instability, which were perfectly apparent to geologists; yet, so far as the writer knows, no geologist was consulted by the engineers until it was too late. The inevitable happened. First, slides continued until the slopes reached the angle of repose; then dams followed, impounding the water to a great depth; next, the dams broke and search parties were out looking for the road, buried under 20 meters of debris. Now, after many years and the expenditure of much money, a new road has been constructed by way of the old Naguilian Trail. We have had to go back to the ridges, following the example of the Spaniards. Of course, if we had cared to, we might have taken a lesson from the native trails, the majority of which follow ridges.

In the matter of engineering technic involved in the construction of these roads, the writer would venture to lay emphasis on the necessity for drainage; keep the foundation of your road drained. The excellence and easy maintenance of the Hawaiian roads is due largely to the very porous subsoil and, consequently, perfect drainage. You may say that this is nothing new, that every engineer knows that; but the application of drainage in America, where the rainfall is merely a light summer shower as compared with the tropical downpour, is a different problem. As to how it should be drained, that is a matter not within the writer's province as a geologist.

Maintenance on a road constructed of poor materials is one thing, while that on a road wherein a wise selection of metal has been the rule is an entirely different thing. In this a geologist with his microscope is a necessity. Petrography, once looked upon as a mere academic study, is now indispensable to the scientific road builder. There is a pathology of rock just as there is a pathology of animal tissue. The microscope will reveal at once, and at little expense, whether or not the minerals composing the rock are sound, whether there is incipient decomposition, or a far-gone state of decay. It will show also the texture or fabric of the rock. If the rock has an ophitic texture, that is, the minerals interlaced to make up a sort of mat, then we may look for toughness. Why one rock splinters and another does not is at once made clear.

At one time the writer collected rock specimens from a number of places along one of the principal Philippine highways, and among the samples

(Continued on page 77)

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*Extract from "Tropical Geology and Engineering," in "The Philippine Journal of Science."

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GOOD ROADS
CONSTRUCTION TRANSPORTATION MAINTENANCE

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Vol. LXI August 10, 1921 No. 6

ROAD CONTRACTORS' PLANT

With the possible exception of cost data, few subjects are of so much importance to road contractors as that of plant.

In a way, too, the matter of plant is an element in the problem of costs, for the difference between a profit and a loss is often just the difference between the right and the wrong equipment or the right and wrong use of plant.

Elsewhere in this issue is the second part of an article on contractors' plant for bituminous road work, one of the kinds of paving that requires a somewhat elaborate lay-out, especially for work of any magnitude. It was written by an engineer connected with one of the leading contracting firms in the road field and embodies the results of both study and experience.

One of the outstanding indications of the progress made in road contracting during the past few years is the development of plant, both in respect to its greater variety and the larger number of units. It is not at all unusual to find the present-day highway contractor working with as extensive and varied equipment as is used on many other building operations. This is partly due to the fact that the larger the road job the more it is spread out and, consequently, the less it is possible to concentrate plant. Unlike the builder of a dam or a bridge, the highway contractor frequently has to meet the problem of transporting materials long distances on the job as well as to and from it.

While the selection of the units of road plant is exceedingly important, probably much more depends upon the effective use of the equipment available. Many road jobs have been failures, so far as the contractor was concerned, because, even with equipment suitable and adequate in every respect, there was a signal failure to put it to the best possible use. Tools are important in every trade, but the way they are used is vital.

ROAD LETTINGS IN THE FALL

Secretary Hoover of the Department of Commerce has added his voice to the demand for the awarding of road contracts in the fall, arguing that such procedure will go far towards relieving unemployment of road labor in the winter and will enable contractors to start early in the spring.

This proposal embodies nothing new, for the plan has been urged repeatedly by officials, engineers and contractors. It has been adopted to some extent, but not nearly so generally as it deserves.

It is hoped that Mr. Hoover's position, his proven ability and his world-wide reputation will carry enough weight to bring about still further adoption of the plan.

Rebuilding French Roads With characteristic enthusiasm and earnestness, France has undertaken the reconstruction of her war-torn highway system. Since the armistice she has rebuilt or repaired some 27,000 mi. of the 33,000 mi. of roads wholly or partly destroyed during the war. At the same time she has reconstructed 2,845 of the 3,220 bridges that were wrecked.

Stronger Bridges Needed Continued reports of bridge failures due to heavy motor truck traffic emphasize the necessity of looking to the nation's bridges in carrying out the highway program. According to competent authorities, the great majority of existing structures are inadequate to the loads they have to carry. These weak bridges are not only serious obstacles to traffic, but they endanger life and property. No road program that does not make ample provisions for bridge work can be effective.

First Aid for Alaska The road system of Alaska and that of the adjacent British province of Yukon are to be connected, an agreement to that effect having been made by the respective road officials. Some wag once characterized our northermost territory as "a body of land entirely surrounded by red tape." That he spoke more than a little truth is evidenced by the fact that Alaska is a country of enormous natural resources that are being left almost entirely undeveloped because of the lack of adequate transportation facilities. The Alaska road authorities have done what they could, but that has been little enough, for they have been hampered by all of the red tape, delay and general inefficiency incident to peace-time efforts of the Army. It seems, however, that our British neighbors are quite awake to the advantages of road connections with Alaska.

Bridge Fires in Pittsburgh. Three bridge fires occurred in the City of Pittsburgh, Pa., within a week. The first resulted in the destruction of the Thirtieth Street Bridge; the other two did little damage. The discovery of the fires on the Seventh Street and the Ninth Street structures at practically the same time, the breaking out of a second fire on the latter shortly after the first had been extinguished, and the occurrence of all three fires within a week have led to the suspicion that all were of incendiary origin. If such is the case, it indicates rather inadequate policing, for all three were discovered at about noon.

Modern Highways Will Complete the Reclamation of an Arizona Desert

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Two inspectors are employed at the Tempe gravel plant and one at each mixer. A resident engineer inspects the forms and subgrade. Besides the chief and assistant engineer, an office engineer, three draftsmen and a testing engineer are engaged in the work. A total of approximately 600 men are employed, including the men in the different shifts.

The movements of trains are controlled by a dispatcher on a motorcycle, who travels about and gives orders to the engineers of the trains. This method is possible because much of the work lies along completed pavement and all parts are accessible by good roads.

R. C. Perkins, County Highway Engineer, has general supervision of the work for Maricopa Co. John F. Horan is general manager for Twohy Bros. Co.

The use of labor saving machinery on this job makes possible the building of such great mileage of concrete roadway—more than 3,000 ft. per day. The adaptation of local aggregates to the work is of particular interest. The layout of the work into nine sections and the coordinating of all the processes results in efficiency, without which labor saving machinery is worse than useless. "Day by day," says James F. Horan, General Manager of the Twohy Bros. Co., "the progress map shows a steady advance in the completed pavement, and although the total to be done is still large; a half a mile a day soon eats up distance. With equipment running smoothly, we look for even better records soon."

And so this part of Salt River Valley, once a desert, is fast being transformed by the hand of man into one of the finest sections of the country. As E. Hackett, Chairman of the Maricopa County Highway Commission, says, "When taking into consideration that we have a winter climate unexcelled anywhere in the world, we believe that we will have to offer the citizens of the United States a winter home that cannot be duplicated in any other section of this country or in Europe. To all those who doubt this statement, we will be ready within two years to prove our assertion with a practical demonstration if the unbeliever will but lend his presence."

Contractors' Plants for Asphalt Paving Jobs

(Continued from page 73)

hauling asphalt can be obtained where the haul is long. The cost of such a tank is relatively small.

Hand distribution in penetration work, although it may give very good results if done with extreme care, is not, in the author's opinion, to be recommended. There are several pressure distributors on the market that do the work in a much more rapid and better manner. A low priced machine which has been successfully used in connection with kettle heating is described as follows:

It consists of a 200-gal. drum, an air pump, and a tank, mounted on a frame supported on a cylindrical roller. The spray nozzles are inserted into the bottom of the drum in which the asphalt is placed. When filling the drum, it is turned so that the nozzles come at the top and it is kept in this position until just before distribution is started. This keeps the asphalt from cooling and plugging the nozzles. The drum is piped to the air tank, and by means of an automatic valve, a constant air pressure can be maintained in the drum containing the asphalt. The air pump is driven by a steam connection from the roller. The framework of the machine is attached to the drawbar of the roller in such a manner that in distributing the asphalt the roller operator only has to concern himself with the steering of the roller, the distributor following exactly the line of travel of the roller. This machine will apply the asphalt in a very satisfactory manner and if the capacity of the kettles is sufficient, 2,000 to 3,000 gal. a day is not too much to expect for an output.

A more expensive machine, but one that is well adapted for jobs on which a large quantity of asphalt is to be manipulated, is of the following type:

A 500-gal. to 600-gal. cylindrical tank is mounted on a substantial 4-wheeled truck having wide-tired wheels, the front and rear wheels not tracking. A firebox is constructed underneath the tank so that direct heat can circulate under and around the lower part of the tank. The spray bars are piped to, and hung from, the rear of the tank. An air pump is mounted on the side of the machine and piped to the top of the tank. When in operation, the distributor is hauled by a roller which also furnishes steam to run the air pump. By an arrangement of valves, a constant air pressure can be obtained on the asphalt in the tank when distribution is taking place. The air forces the asphalt out of the tank through the spray nozzles onto the road. The firebox is an important feature of this distributor because it furnishes a means of rapidly raising the temperature of the asphalt to any degree desired. This machine can be used in conjunction with heating the material in kettles, but a larger output may be obtained if the asphalt is taken from a tank car delivery. On short hauls the distributor may be loaded directly from the tank car, but on long hauls it is better to keep the distributor on the road and fill it from hauling tanks which have been loaded at the tank car. Although not ordinarily done, it is possible to spray widths up to 18 ft. with one passage of this machine by making the spray bars sufficiently long.

Many of the motor truck distributors previously mentioned have a small steam boiler mounted on the truck for the purpose of heating the asphalt while in transit and, in cases where air pressure is used in distributing the asphalt, the boiler furnishes the steam necessary to run the air pump. Asphalt can be applied more rapidly by motor truck distributors than by the two machines previously described, and a contractor will ordinarily use such means of distribution when same can be furnished at a cost which does not exceed too greatly the cost of some of the slower methods.

Placing and Spreading

In the construction of asphalt roads by the penetration method, a considerable volume of the finer sized stone is required for covering the several applications of asphalt. This covering material is stacked on the shoulders of the road in small piles. Care should be taken not to make the piles too far apart, but to have several to each hundred feet. A man walking any distance with a shovel of material before spreading it costs money. The piles should be near enough together so that such unnecessary labor will be avoided. Material which is to be placed on the shoulder should be brought on the job ahead of the material which is to be spread on the subgrade. Hauling methods and traffic requirements will determine the best method of spreading the stone.

Where stone is brought to the job in bottom dump wagons, the labor of spreading can be lessened by chaining the bottoms so as to string the stone in windrows parallel to the road and a road machine can then be used to further spread the windrows across the road. Reversible dump wagons are usually built so as to spread the load at right angles to the center line of the road and by chaining the doors the stone may be placed about as required.

Some end dump trucks are equipped with an arrangement on the tail board so that the tail board opening is regulated as the truck is dumped. With a skillful operator a truck load can be spread quite uniformly at almost any desired depth, and for the width of the truck body. A stone spreading device is made for use with dump trucks, which largely eliminates hand labor. This device consists of a hopper to which an adjustable V-shaped plow is attached. The hopper and plow are hitched close behind the truck so that as the truck dumps the stone it falls into the hopper. As the truck moves along the road, the stone flows from the hopper through a gate and is spread to any desired width up to 16 ft. by the V-shaped wings. The depth to which the stone is spread is controlled by the adjustable gate in the hopper and by raising or lowering the plow wings. Courses as thin as 2 in., loose measurement, have been spread with this device, so that a slight truing up by hand was all that was necessary to complete the work. The writer has found that better results are obtained by making the maximum width of spreading at any one passage not over 10 or 12 ft.

Certain quarries can deliver stone by trolley. Usually stone cars are built especially for such work that will dump the stone alongside the trolley track. Where a job parallels a trolley road on which stone may be received in such manner, the best way to handle the delivery is by means of a team and scoop scraper.

Geological Aspects of Road Construction and Maintenance in the Philippines

(Continued from page 74)

was one that yielded a briquet which when placed in the Page cementation machine did not break under 2,000 blows, whereas an ordinary basalt briquet yielded at the 22d blow. A thin section of the fresh rock was made and examination showed that there was a small amount of secondary calcite in the rock, an alteration product of the lime-bearing silicates; it was this that furnished the excellent binding qualities. The rock was a diorite just beginning to decompose without having gone so far as to reveal this condition to the naked eye. This rock, with its holocrystalline texture and just the right amount of calcite, would make a most excellent road metal because it has two essential qualities, namely, toughness and high cementation quality. Of course, the objection of high cost will be raised at once; but no matter how the finances stand, there is never any excuse for putting worthless and unsuitable rock on a road. The proper way is to let the geologist recommend one or more kinds of material, and then the engineer may consider which he can afford to use. Many state highway departments now follow this method, and formerly the engineers of the Philippine Government always submitted their road and building materials to the Bureau of Science for the proper tests. Of late years this has not been done, and the results are beginning to appear.

Still another important factor to be considered in connection with the cementation quality of the road metal is that of the wind. During a typhoon, a storm which is much like the Gulf hurricane, the velocity of the wind is as high as 165 kilometers (103 mi.) an hour and the roads are swept literally by a natural cyclone blower and all loose material is removed as effectually as if a vacuum cleaner had gone over them. So we must consider not only the work of the deluge of rain but the combined effect of water and driving wind. Road maintenance from these and other causes is a very serious problem, in the Philippines at least, and any criticism of our highways should be tempered by a consideration of the difficulties we have to overcome.

Two chief sources of trouble in concrete mixtures in the Philippines are found; first, the fineness and generally poor quality of the sand, and second, lack of strength of the crushed rock. Both Reibling and King, of the Bureau of Science, have repeatedly called attention to these weaknesses in local concrete, as revealed by their long series of actual tests made on thousands of samples. The ultimate cause for this condition of things is found in the mineralogy and geology of the raw materials employed. Not only is the mineral composition of the sand commonly used here unsatisfactory, but also the extremely weathered condition of the materials is a matter of menace. Now it is agreed that the practical tests are of prime importance in the proving of such materials, but the examination of the sand and of thin sections of the rock is also of very great value. Such examination will reveal the cause for the failure; and, of course, this is really the most important thing of all, if we want to avoid future trouble of this kind.

The so-called "sand" oftenest used here is sand only by courtesy. The microscope reveals little or no quartz, the feldspar present is often in a fargone condition of decay, and the predominant minerals are often dark colored hornblendes, pyroxene, olivines, etc. To one accustomed to the clear, white, sharp Ottawa sand used in standard tests, the local sand appears more like dirt.

Reverting to the subject of landslides, a thorough acquaintance with tropical conditions will reveal at once the futility of attempting to control slides like those of the Culebra cut at Panama. Retaining walls, drainage, etc., are all makeshifts. The only practical and final solution of the problem is to increase the sliding until the walls are brought to the angle of repose where they will no longer slide. According to MacDonald, geologist of the Canal Commission, the most important types of slides were structural breaks and deformations and for this type of slide there was only one remedy that had utilitarian value under the conditions involved, and that was applied. It consisted of making the slopes less steep by removing material from their upper parts until the balanced pressure at the foot of the slope became less than the crushing or deforming strength of the rock. In other words, the slopes were brought down to the angle of repose.

This was recently well illustrated at Eugene, Oregon, where both the formation (weathered basalt) and the rainfall simulate tropical conditions. A hillside of this material, becoming saturated with rain water, started to slice off, slide, and flow under a large lumber mill at the bottom of the slope, bulging the latter upward, completely throwing it out of alignment and even threatening the structure. The simple expedient of sluicing at the foot of the slide solved the difficulty and the material of the hill was brought to such an angle that it no longer moved.

Federal Motor Tax Proposed

Measure Levying 40 Cents per Horse Power Opposed by A. A. A. President

A bill providing for the levying of motor vehicle fees by the Federal Government was introduced in the House on July 28 by Congressman Appleby of New Jersey.

These fees would be in addition to state fees and licenses would be issued through the state motor vehicle commissioners, 10% of the proceeds going to the states where originating and 90% going to the Federal Government. The bill provides a fee of 40 ct. per horse power for pneumatically equipped vehicles and a graduated scale for motor trucks according to carrying capacity.

The American Automobile Association is vigorously opposing the creation of a federal motor tax, notwithstanding the fact that it is sponsoring a federal system of highways, as provided in the Townsend Bill.

"The 10,000,000 motor vehicle owners," says Geo. C. Diehl, President of the American Automobile Association, "are now paying taxes aggregating $348,769,878 annually.

"Fundamentally, the motor vehicle is an element in transportation and if, as Secretary of the Treasury Mellon has indicated, we should repeal or cut down transportation taxes, then certainly the burden on this factor in highway transportation which last year was estimated to have hauled more than 1,000,000,000 tons of freight and carried 5,000,000,000 passengers, is entitled to the same consideration as the older agencies.

"It is unnecessary to indicate how deeply the motor vehicle has penetrated into farm life. It is enough to say that 72% of all cars are sold in towns having a population of 50,000 or less, 55% in towns of 5,000 or less and 33% in towns of 1,000 or less.

"Today the entire cost of construction and maintenance of state highways is levied against the motor vehicle in many states. The preemption of this source of revenue by the states would be immediately interfered with by any further federal tax and would cause a strong and reasoned protest by state legislatures who already see many of their earlier sources of revenue taken over by the Government."

France Rebuilds Damaged Roads

France is rapidly repairing the damage done by the war. At the armistice 3,256 villages and towns had been abandoned; all but 40 have been reoccupied. Of 52,734 km. of damaged highways, 43,595 km. have been rebuilt or repaired. Out of 3,220 bridges damaged or destroyed in the war, 2,845 have been reconstructed.

Two More Pittsburg Bridges Afire

The Seventh and Ninth St. Bridges over the Allegheny River, Pittsburgh, Pa., were discovered on fire shortly after noon on July 23. Still alarms were sent to nearby fire houses and the flames extinguished without much damage. A little later fire again broke out on the Ninth St. Bridge, but was put out with little damage resulting.

These fires, occuring within a week after the burning of the Thirtieth St. Bridge, are believed to be of incendiary origin.

Recent Bridge Failures

Concrete Floor on One Bridge Declared Too Heavy for the Structure

Scarcely a week goes by without reports of failures of bridges, especially under motor truck traffic. This is to be expected, since it has been estimated by good authority that 80% of the highway bridges in this country are a menace to traffic. This week we report the following failures:

A bridge over Ridley Creek in Chester County, Pennsylvania, collapsed just as a motor truck left it. The structure was of iron, built in 1869.

A lumber truck recently went through the concrete floor of a steel truss bridge in Mercer County, N. J. County Engineer Harris has stated that the concrete floor will probably be removed and a wood block floor substituted, as the concrete is regarded as too heavy for the bridge to carry.

Another bridge in Mercer County, New Jersey, over the Shababunk Creek, failed after a heavy truck passed over it. Traffic is detoured while repairs are being made.

Crops Rot Because of Poor Roads

At a recent meeting of the Poteet-Leming-San Antonio Good Roads Association, Texas, members stated that melons and tomatoes rotted in the fields because of poor roads. J. W. Howard, a landowner in the Poteet District, stated that the wastage of melons would have paid for the construction of the 6 mi. of road to Leming.

Will Connect Yukon and Alaska Roads

A series of conferences has been held between George P. McKenzie, chief executive of the Yukon, and Col. James G. Steese, President of the Alaska Road Commission, and it has been agreed to connect the road systems of the two territories. Work will be started to carry out this agreement as soon as possible.

Hoover Urges Fall Lettings

Secretary of Commerce Hoover has sent letters to the governors of the states suggesting that the letting of road contracts in the fall rather than in the spring would do much to relieve the unemployment of road labor during the winter months. Much material can be moved in the winter, said the Secretary, and road work can be carried on more rapidly if an early start is made in the spring.

◆

The City of New York has appropriated $2,000,000 for the purchase of street cleaning equipment.

◆

Cocke County, Tennessee, will hold an election on Aug. 20 to vote on a $200,000 road bond issue.

The Lenoir and Blowing Rock Turnpike Co., Lenoir, N. C., has offered to sell its road, 22 mi. long, to the State Highway Department for $40,000. This road is an important one in western North Carolina, furnishing access to Watauga and Avery Counties from the central part of the state.

A Pontoon Bridge across the Hudson River at Yonkers, N. Y., is authorized to be built in a bill introduced in Congress on July 27 by Senator Frelinghuysen. This bridge is to be built by a private corporation, whose charter life will be limited to ten years after the completion of the bridge, during which period it is expected the proposed vehicular tunnel and bridge will be completed.

MEETINGS

Calendar of Coming Meetings

Aug. 24-25.—Custer Battlefield Hiway Association.—Annual convention, Mitchell, S. D. W. D. Fisher, Secretary, Sheridan, Wyo.

Aug. 30-Sept. 1—Michigan State Good Roads Association.—Annual meeting, Flint, Mich. P. T. Colgrove, Pres., Hastings, Mich.

Oct. 24-28—American Society for Municipal Improvements—Annual Convention, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Safe Roads Federation of Massachusetts

A joint meeting of the Safe Roads Federation of Massachusetts and the Massachusetts Police Chiefs Association was held in Boston on July 19. Lewis E. MacBrayne, General Manager of the Massachusetts Safety Council, presided at the sessions.

Among the speakers were Capt. Bernard J. Hoppe, of the Boston Traffic Division, who spoke upon traffic regulation in Boston; Frank A. Goodwin, State Registrar of Motor Vehicles, on "Standardizing Traffic Signals and Methods in Massachusetts"; Charles W. Price, General Manager of the National Safety Council, Chicago, on "Creating Public Opinion to Back Law Enforcement."

Recommendations were passed for giving traffic officers the same power by law over pedestrians that they have now over motor vehicle operators and for the teaching of "safety first" in schools and churches.

PERSONAL MENTION

M. W. Smith, Jr., has been appointed assistant city engineer of Clarksburg, W. Va.

Norman W. Warren has been appointed general manager of the Dominion Bridge Co., Ltd., Winnipeg, Canada.

O. M. Leland, formerly with Cornell University, is now dean of the engineering department of the University of Minnesota.

Paul Doty has been elected chairman of the Minnesota Board of Registration for Architects, Engineers and Land Surveyors.

Benjamin Bean, formerly with the California State Highway Department, is now field engineer with the Missouri State Highway Department.

OBITUARY

William Kennedy, formerly Superintendent of Public Works of Ontario, Canada, died recently.

Joseph P. Boucher, a well known bridge builder of Canada, recently died in Ottawa, Ont., at the age of 71.

W. E. Stone, President of Purdue University, was killed on July 27 on Mt. Eon, Alberta, Can., by a fall while mountain climbing.

John E. Sprott, for 35 years provincial road superintendent of British Columbia, died at New Westminister, Canada. He was 81 years old.

William Baird, a prominent bridge builder, died recently at Cambridge Springs, Pa., at the age of 74. Mr. Baird was born in Canada, moving to Pittsburgh, Pa., early in life. In 1892 he built the Sixth St. Bridge, Pittsburgh, Pa., and was engaged in bridge construction for about twelve years, erecting a score of bridges in different parts of the country. About 25 years ago he retired from the bridge business and bought the Riverside Hotel, Cambridge Springs, Pa., which he operated until his death.

◆

The State Highway Department of Kansas has 344 mi. of road under construction.

The State of New York completed 22 mi. of highway during the week ending July 2.

The State of Pennsylvania has disposed of its entire issue of $15,000,000 of state highway bonds, of which about $9,000,000 was sold in June.

A Bill was Introduced in Congress by Representative Goodykoontz on July 27 which calls for an appropriation of $1,000,000,000 for road construction.

Governor Len Small of Illinois is on a prolonged inspection trip of the roads of the state. It is not expected that he will inspect the roads in Sangamon County.

Jackson County, Mississippi, is offering for sale $387,000 of road bonds. The proceeds will be used with federal funds to construct a highway across the southern part of the county.

Four Claims against the State of New York aggregating $38,000, have been filed by motorists who contend that accidents were caused by the improper maintenance of state roads.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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A substantial Slag Road built with Tarvia —

The photographs show two sections of the Hopwood to Brownfield Road, South Union Township, Fayette County, Pa.

This road was built over an old water-bound base by the Township Supervisors with their own forces. A five-inch course of Dunbar Bank slag was used as road metal. The slag was bound with "Tarvia-X" applied by the penetration method. A deferred "Tarvia-B" seal coat was applied two months after completion.

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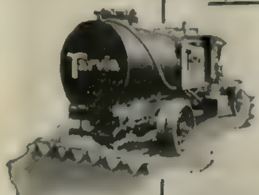

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GOOD ROADS

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The Great Western Gateway

One of the Longest and Most Beautiful Highway Bridges in New York State to Carry an Important Trunk Road over the Mohawk River and the Barge Canal between Schenectady and Scotia—Main Span to be a Concrete Arch 212 Feet Long—History of Bridges Replaced

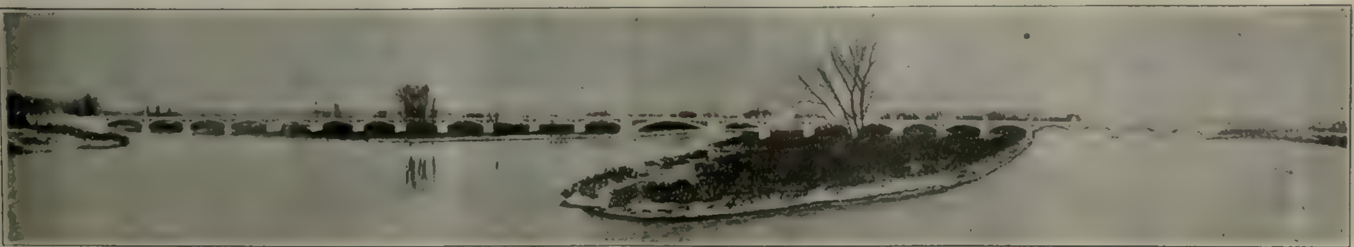
By JOHN J. BIRCH

The Great Western Gateway, the break in the mountains through which the Mohawk River flows to join the Hudson, will soon be marked by a concrete bridge of unusual proportions and striking beauty of design. Connecting the City of Schenectady and the Villiage of Scotia, it will carry over the Mohawk and the Barge Canal one of the main east and west trunk lines of the New York state highway system, eliminating several bad curves and replacing an old iron structure that long ago became inadequate to the traffic of motor-driven vehicles.

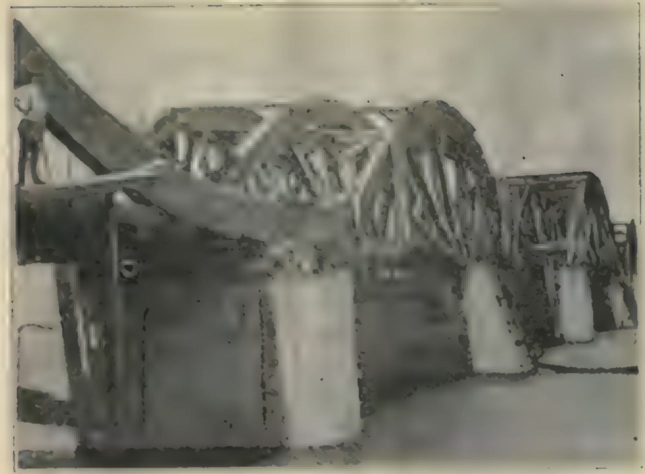
Since the early days of the westward drift of population, the Mohawk Valley has provided an important route to western New York, Ohio, and the country beyond; and the three bridges across the river at Schenectady—the first of wood, the second of iron and the third of concrete—typify the progress of American highway bridge design.

Prior to 1800, three ferries were maintained, but because of their inefficiency the Mohawk Turnpinke & Bridge Co. was organized in that year for the purpose of erecting a bridge over the Mohawk and constructing a turnpike to Utica, some 80 mi. to the west. In 1808 the first bridge, shown in one of the accompanying illustrations, was constructed. It was designed by Theodore Burr, who was a cousin of Aaron Burr and was considered the greatest bridge engineer in the United States at that time. It was a wooden suspension bridge and has been pronounced the master effort of Burr and the most unusual timber bridge in America. It consisted of four spans, from 157 to 190 ft. long, carried by "cables" constructed of 4x4-in. planks bolted together to form three ribs each 14 in. wide and 32 in. deep and approximately 1,000 ft. in length. The timber was cut in Montgomery County and floated down the river to Schenectady. The chords were attached to anchorages on the shores, each being about 70 ft. long and consisting of posts laced and cross-braced. The floor was supported by iron suspenders.

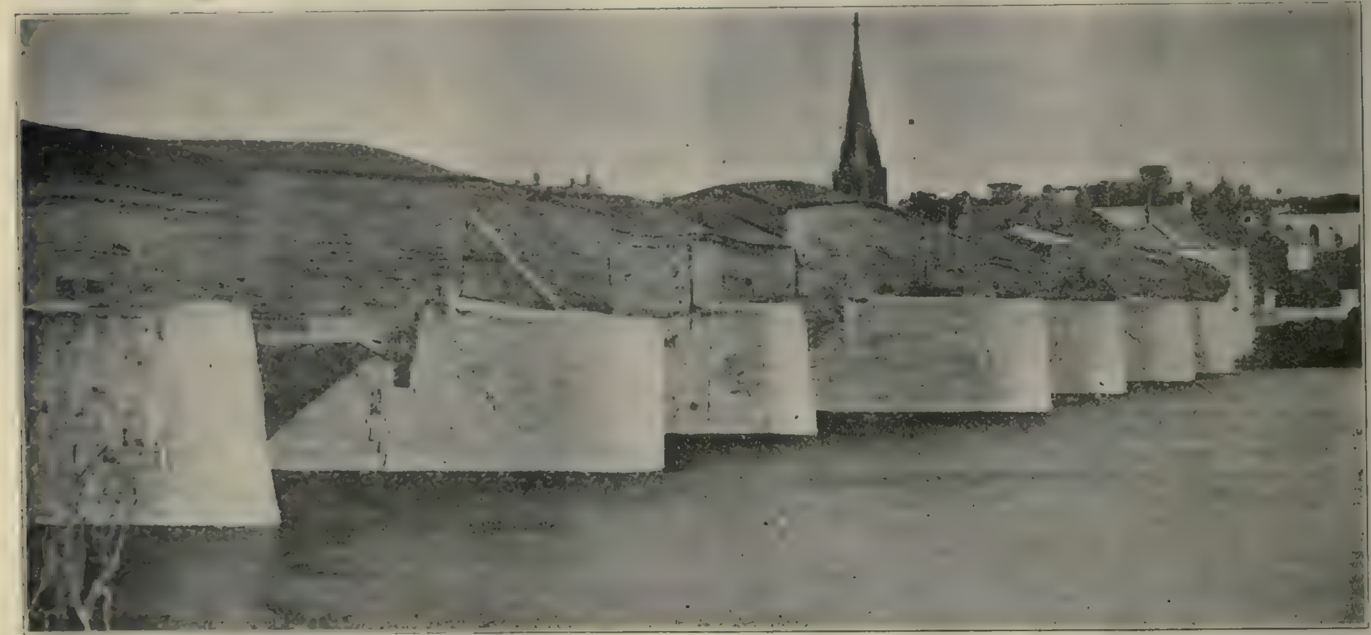
When the bridge was built, it was carried by the abutments and three piers which projected above the floor on the westerly side to protect the structure from ice and the spring freshets. Later the bridge began to sag and four additional piers were built, one under the center of each span, and the whole structure was covered. The bridge was lighted at night by four small oil lamps, two on each driveway. After covering, it was lighted during the day by an opening 3 ft. square over each pier.



THE GREAT WESTERN GATEWAY, A HIGHWAY BRIDGE OVER THE MOHAWK RIVER AT SCHENECTADY, N. Y., AS IT WILL APPEAR WHEN COMPLETED



THE OLD WOODEN BRIDGE DESIGNED BY BURR AND COMPLETED IN 1808—VIEW AFTER THE BUILDING OF ADDITIONAL PIERS



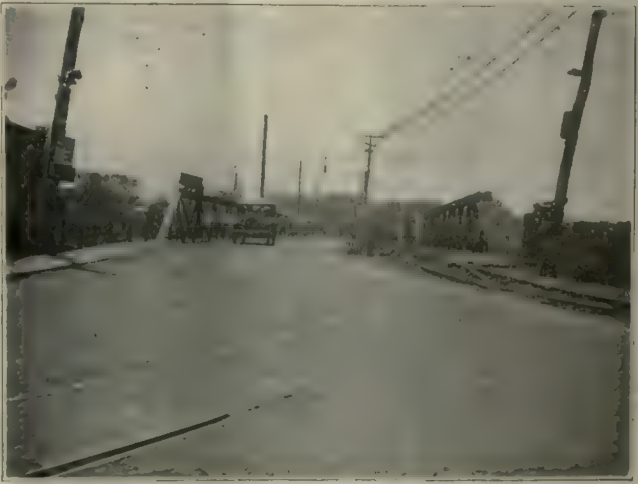
THE OLD BRIDGE AFTER BEING COVERED—TORN DOWN IN 1874 AND REPLACED BY THE STRUCTURE SHOWN IN ILLUSTRATION BELOW

At the Schenectady end there were two immense toll gates which could be opened from the toll house but had to be closed by hand. The tolls were fixed by law, but increases were made repeatedly. In 1815, a "burthen wagon" with one horse was charged 12.5 ct., a one-horse stage 18.75 ct., and sleighs 12.5 ct. School children were allowed to cross free, but when carried in a wagon all in excess of two were charged for at the rate for pedestrians.

The bridge was used until 1874 when the timbers became decayed, the masonry cracked and the floor uneven. The public urged its removal until June 20, 1874, when the structure was sold for $500. Tearing it down proved no easy task, for the rods and bolts had so rusted that it was necessary to saw the timbers. Large amounts of timber were sold to residents along the river and were used to build barns and other structures, some of which are still standing.

In November, 1874, the present structure was completed by the Remington Agriculture Co. for the Mohawk Turnpike & Bridge Co. The items of cost of the work are interesting in the light of present prices. The costs were as follows: Cash paid to bridge company, $12,000; filling in abutments, $589.65; Remintgon Agriculture Co., for iron superstructure, $26,993.07; erection of toll house, $169.95; stone abutments and piers $558.75; raising and repairing abutments and piers, $15,076.23; rip-rap, $2,015; driving piles and crib work, $2,079.81; stone for approaches, $149.78; engineer, $1,125; total $59,755.34.

Under authority granted by an act of the Legislature, the Town of Glenville purchased this bridge and Freeman's Bridge, and made them free to the residents of the township. When the Schenectady



APPROACH TO PRESENT BRIDGE SHOWING CURVE AND BAD TRACK LAYOUT

Railway extended its line to Scotia, the piers were enlarged and the footbridge moved from the westerly side to the easterly side. The bridge was then as it is today.

Before the automobile came into use, this bridge was a source of continual expense to the township and at one time it was offered to the City of Schenectady for one dollar, but the offer was rejected. After a new bridge had been decided upon and the Governor had signed the bill providing for its construction, condemnation proceedings dragged on for several months but finally the sum of $155,000 was awarded and on March 11,1921, the comptroller of Schenectady paid the supervisor of Glenville $116,250, the law providing that only 75% of any sum allowed by the commission shall be paid. Of the amount it received, the Town of Glenville had to apply $48,000, Scotia's allotment, towards the construction of the new bridge.

COFFERDAM FOR ONE OF THE RIVER PIERS OF THE GREAT WESTERN GATEWAY

This new structure, the Great Western Gateway so-called, is the result of an agitation that lasted a number of years. The increasing number of motor cars and trucks have brought an excessive burden on the old iron structure. It is on one of the direct roads to the west and is said to be crossed by more automobilists than are any other bridges in the state except those in New York City. On the first Sunday of August, 1916, the 10-ct. tolls collected during a 16-hour period brought in a total of $331.20, indicating a traffic averaging more than 200 cars an hour. From Jan. 1, 1918, to Jan. 1, 1919, the total amount collected from automobile tolls was $21,498.57. This sum was collected from less than half of the cars using the bridge, for car owners of Glenville and Scotia are allowed free passage. With this local traffic, the number of cars using the bridge in a year would amount to about 645,000, or an average of some 54,000 a month.

On April 18, 1919, a bill providing for the construction of a new bridge was introduced by Senator Yelverton. It was passed by the Senate, 48 to 3 and later by the House by a vote of 91 to 39. The measure met with the hearty endorsement of the city authorities of Schenectady and on May 13, 1919, fearing that the governor would not sign the bill, practically every large firm and industry in the city sent a delegation to Albany by automobile to back up a committee that urged upon the governor the purchase of the present structure and the construction of the new bridge. Two days later Governor Smith signed the bill, setting forth his reasons for so doing in the following memorandum:

> The bill provides for the construction of a bridge over the Mohawk between the City of Schenectady and the Village of Scotia to supersede the present structure connecting these two municipalities, parts of which have been in use since 1806. The old bridge has outlived its usefulness and will have to be replaced. It is a toll bridge and, therefore, its franchise should be abolished in the march of modern progress. Furthermore, its approaches are at so low a level that at times of high water, frequently occurring, they are under water to such an extent as to render crossing impossible. This structure crosses the Barge Canal and the state, under the referendum providing for the issue of bonds raising the funds for that project, was obliged to reconstruct highway bridges crossing the canal. The sum of $500,000 has been reserved from the avails of these funds to rebuild. The City of Schenectady will contribute $100,000 in cash and acquire the approach on its side to build an abutment, in addition to acquiring outstanding toll franchises. The Village of Scotia proposes to pay the cost of the approach on its side and will contribute $50,000. The remaining cost will fall on the state. I consider that the increase of the state's revenue, by reason of the automobile tax, which is applicable only to highway purposes, will offset the cost of this work, and in ensuing fiscal years when it will have to be met by appropriations from the state funds. The local municipalities have contributed liberally to this great enterprise which is so earnestly demanded by the traveling public. It is along the line of our reconstruction policy, in that its erection will give employment to workmen in a locality where labor conditions at present are not favorable. For these reasons, among others, I believe that this bill should be approved.

VIEW LOOKING TOWARDS THE SCHENECTADY APPROACH—CANAL TERMINAL AT RIGHT

(Concluded on page 88)

Tests for Soils with Relation to Their Use in the Subgrade of Highways---I*

Mechanical Analysis—Water Holding Capacity—Moisture Equivalent—Vertical Capillarity —Air Shrinkage—Time of Slaking and Cementing Value—Adsorption Test— Comparative Bearing Power—Discussion of Results Obtained

By A. T. GOLDBECK and F. H. JACKSON†

Owing to radical changes in the character of traffic on our highways, the problems of road design are today different in some respects from those of ten years ago. This condition has largely been brought about by reason of the extensive use of heavy motor trucks. With increasing wheel loads, we have come to recognize the great importance of obtaining adequate support for our road surfaces so that they will not be unduly distorted under heavy loads. It is well known to road engineers that identical types and designs of roads are not equally successful in carrying like traffic in different parts of the country. Even though constructed with equal care, some road surfaces fail utterly while others carry equal traffic with little maintenance expense. The explanation of this difference must lie in the difference in support offered by the subgrades to the road surfaces. Practical road engineers know, in a general way, that certain types of soils, when saturated with water, have very little bearing value and that others have comparatively high bearing value. They also know, in general, that certain soils are impervious, but that when once saturated are extremely hard to drain; and further, that other soils, owing to their porous structure, drain very readily.

It would serve a very useful purpose if the difference in these soil types, which affects the stability of the road surface, could be definitely and accurately recognized through the medium of laboratory tests; and it is the aim of this paper to briefly discuss some of the tests which are being investigated at the present time by the Bureau of Public Roads in an effort to finally determine which of them are most satisfactory.

The laboratory has worked out a series of tests designed to give some information regarding the following physical properties of subgrade materials: Gradation, water holding capacity, moisture equivalent, vertical capillarity, air shrinkage, slaking time, cementing value, and the percentage of colloidal material as determined by adsorption. The relative bearing power of the soil under various conditions of density and moisture content is also being investigated.

Preparation of Soil Samples

One of the most difficult problems in connection with the laboratory examination of soils is that of preparing materials so that they may be accurately sampled and studied. Many soils when received in the laboratory are so lumpy due to the clay content that it is exceedingly difficult to break them up without actually crushing some of the grains. It has been found, however, that most soils if handled carefully, may be prepared for testing substantially in accordance with the following scheme:

A 1/5-cu. ft. sample of the soil as received from the field is broken up in a porcelain mortar, using a rubber-covered pestle, until the lumps of clay are small enough to pass through a ¼-in. screen. Great care must be exercised, especially with certain materials containing soft or friable sand, to prevent crushing of the grains. That portion of the sample which is retained on the ¼-in. screen is considered as gravel and is not used in connection with any study of the physical properties of the soil with the exception of its mechanical analysis and bearing power. The material passing the ¼-in. screen, consisting of sand and clay, is then passed through a soil pulverizer which consists essentially of two adjustable rubber rolls operated by an electric motor, between which the soil is fed. The rolls are adjusted to allow the soil to pass through them without clogging and yet with sufficient pressure to pulverize the clay fragments. By feeding the soil through very slowly it has been found possible to satisfactorily reduce most of the soils so far encountered. In especially obstinate cases it may be necessary to complete the preparation of the soil by rolling it out in a very fine layer on a rubber pad. It must be borne in mind, however, that the preparation of a clay soil for testing is an operation requiring great patience and care. The accuracy of the results of many of the tests depends largely on whether the sample has been reduced to its ultimate degree of fineness, at least in so far as it is possible to accomplish this end by mechanical means.

Mechanical Analysis

The method of mechanical analysis used in a modification of the method of soil analysis developed many years ago by the U. S. Bureau of Soils. Unlike the latter, however, there is no attempt made to separate the extremely fine grain sizes, a process which requires either prolonged sedimentation or centrifuging. The object of this test is simply to separate the fine silt and clay from the sand so that a sieve analysis of the latter may be made. The method also gives by difference the amount of combined clay and fine silt in the soil. The procedure is as follows: A 500-g. sample of the soil, obtained by quartering the material prepared as previously described, is passed through a 10-mesh sieve and the material retained thereon is recorded as coarse sand over 10-mesh. In case there is an appreciable quantity of gravel in the soil its percentage is computed from the weight of material retained on the ¼-in. screen as obtained during the preparation of the sample. A 50-g. sample of the soil which will pass a 10-mesh sieve is then obtained, great care being taken to sample accurately. The sample is placed in a glass jar about 15 cm. in height and 8 cm. (see Fig. 1) in diameter and provided with an aluminum screw top. Two hundred cubic centimeters of water and 5 cc. of dilute ammonia water are added and the jar is revolved in an agitator for one hour for the purpose of disintegrating any aggregations of soil particles which exist. The agitator consists of a wooden frame holding six jars so placed that they revolve about an axis perpendicular to the long axis of the jars. A view of the agitator is shown in Fig. 2. The contents are thus thrown from end to end of the jars twice during each revolution, thus insuring maximum agitation. The jars revolve at the rate of 16 r. p. m. The function of the ammonia is to prevent flocculation of the clay particles. The jar is then removed from the agitator and the contents allowed to settle for 8 minutes after which the water containing the material in suspension is siphoned off to a depth of approximately 8 cm. (see Fig. 1). The soil is again brought into suspension by means of a fine water jet under approximately 20 lb. pressure, and the above process repeated. The operation of washing, sedimentation and siphoning is continued until the wash water is approximately clear after 8 minutes sedimentation. A few drops of ammonia water are added after each washing. The soil in the jar in then dried at 100° C. and a sieve analysis made, using standard 20, 50, 100 and 200-mesh sieves. It will be noted that the above processs divides the soil into four grain sizes which may be designated as "sand;" one (the material which will pass the 200-mesh sieve by analysis) which may be designated as "silt"; and one (the material removed by washing) which is a combination of fine silt and clay. The maximum grain size remaining in suspension after 8 minutes is approximately 0.030 mm. as determined by the method of the Bureau of Soils referred to above.

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*Paper presented at the 24th annual meeting of the American Society for Testing Materials, Asbury Park, N. J., June 21-24, 1921.

†Engineer of Tests, and Senior Assistant Testing Engineer, respectively, U. S. Bureau of Public Roads.

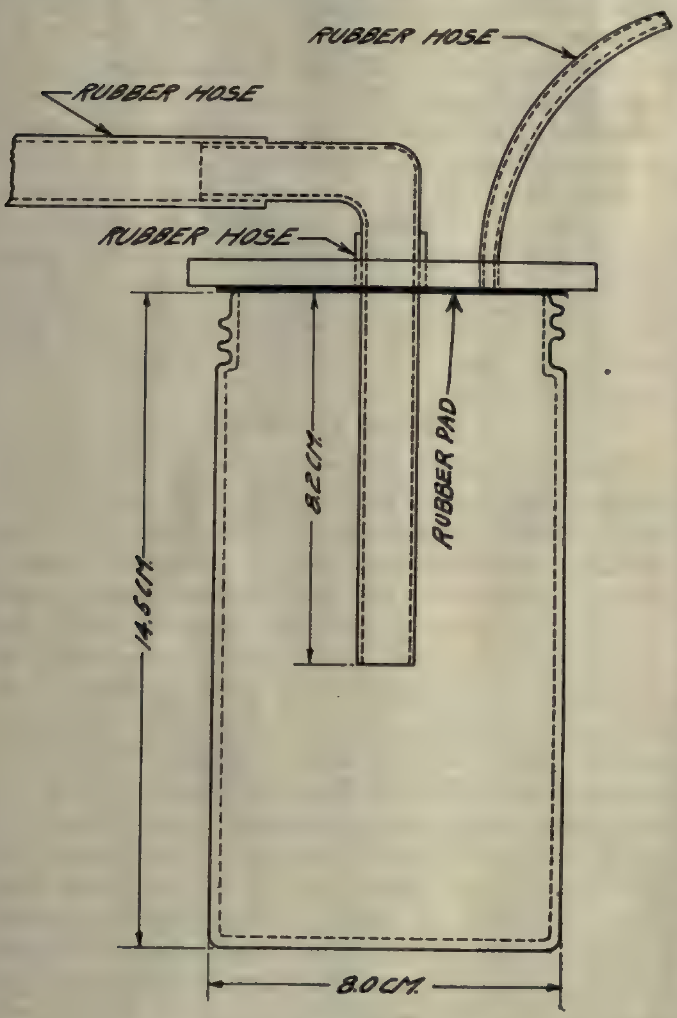

FIG. 1—SYPHON TUBE

Water Holding Capacity

The water holding capacity of a soil may be considered as the maximum percentage of water which it is capable of retaining under any circumstances. The test for it is made in the laboratory in the following manner: A sample of the soil which has been prepared as described above is placed in a brass

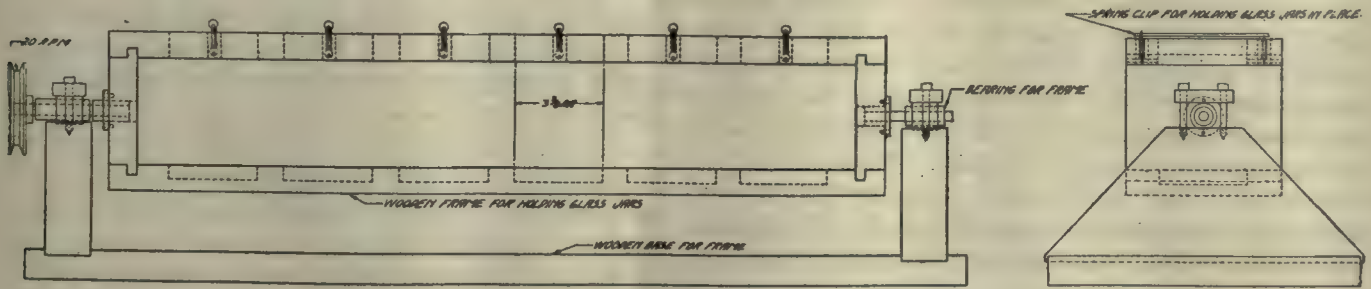
20 R.P.M.
SPRING CLIP FOR HOLDING GLASS JARS IN PLACE.
BEARING FOR FRAME
WOODEN FRAME FOR HOLDING GLASS JARS
WOODEN BASE FOR FRAME

FIG. 2—MACHINE FOR WASHING SOIL SAMPLES

cylindrical box 1 cm. high and approximately 6 cm. in diameter. The bottom of the box is perforated with 150 holes each 1/32 in. in diameter. The top of the soil is then struck off by means of a fine straight-edge and after weighing it is placed in a pan of water on a brass triangle and submerged just below the surface of the water for one hour (see Fig. 3). The surface water is then blotted off and the sample immediately weighed. The water holding capacity is determined on the basis of the dry soil.

Moisture Equivalent

The purpose of the so-called moisture equivalent determination is to obtain a measure of the power of the soil to retain moisture against the action of gravity. In other words it may be considered as an index of the difficulty which is likely to be encountered in draining the soil by ordinary methods. The term "moisture equivalent" has been defined by Briggs and McLean* as the percentage of moisture which is retained by a soil when it is subjected to a centrifuge force equal to 1,000 times the force of gravity. In the preliminary work of the Bureau of Public Roads, a centrifuge rotating at a speed of 2,000 r. p. m., when filled, has been used. The centrifugal force produced by this machine is approximately 750 times the force of gravity, so that all the determinations for moisture equivalent which have been made are somewhat lower than the true moisture equivalents of the soil. For purposes of comparison, however, the results serve the useful purpose of indicating the relative degree with which various soils will retain moisture. This determination is made on a 5-g. sample of the soil which has been prepared as previously described. The soil is placed in a Gooch crucible and allowed to take up water by vertical capillarity until saturated. The crucible is then placed in a Babcock cup containing a small rubber stopper to serve as a cushion and provided with a hole sufficiently large to take the water thrown out during centrifuging. The cup is provided with a brass cap to prevent evaporation. An arbitrary limit of one hour has been fixed as the time of centrifuging. This time is not in every case sufficient to throw out the maximum amount of water at the speed used. It is considered to be sufficiently accurate, however, for the work in hand. Moisture equivalents are obtained by weighing the soil after centrifuging, drying to constant weight in an oven of 100° C. and again weighing. The moisture equivalent is the percentage of water, based on the dry weight of the soil, which is retained after centrifuging.

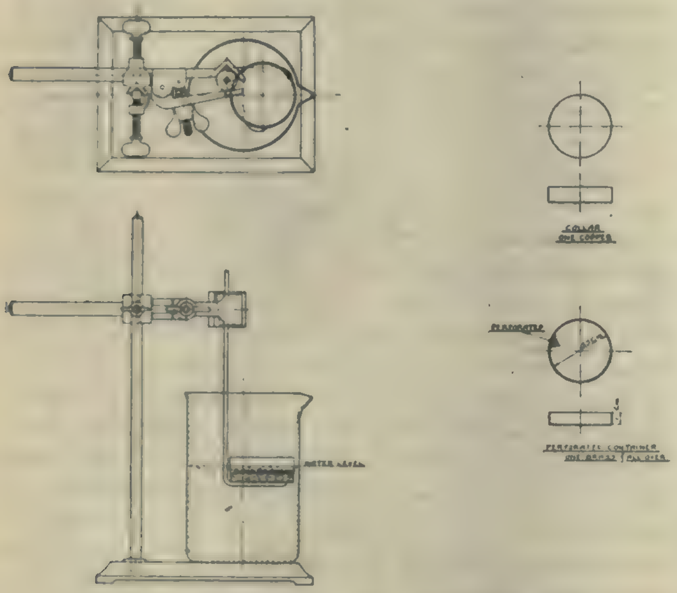

FIG. 3—APPARATUS FOR DETERMINING WATER CAPACITY OF SOILS

Vertical Capillarity

This determination is made for the purpose of ascertaining the average percentage of water which will be lifted a distance of 20 cm. in a column of dry soil 25 mm. in diameter. It is of value for comparative purposes only, and does not necessarily bear any relation either to the total capillary lift of the soil or the maximum percentage of water which it is capable of holding by capillary attraction. A sample of the soil prepared as described is poured loosely into a 25-mm. glass tube and the tube is jarred until a height of 20 cm. has been reached and no further settlement takes place. A piece of cheese cloth is fastened to the lower end of the tube to hold the soil in place. The lower end of the tube is then just immersed in water. When capillary water reaches the top of the soil column the tube is weighed and the amount of water taken up by capillarity thus determined. This weight, expressed as the percentage of the dry weight of the soil, may be considered as the average percentage of moisture which will be taken up by capillarity under these conditions.

Air Shrinkage

The maximum contraction in volume which will take place in a given soil when dried in air at ordinary temperatures is of interest in connection with the study of the physical properties of soils. An approximate determination may be made in the following manner: A sample of soil passing the 10-mesh sieve is mixed with a quantity of water approximately equal to its moisture equivalent. The soil is then placed in a small flat cylindrical porcelain dish approximately 6 cm. in diameter and 1 cm. high, struck off level with a small trowel and weighed. The sample is then placed in a desiccator and weighed at frequent intervals until no further loss in weight is recorded. The percentage of the final volume in terms of the original volume is determined by filling the pan containing the dried soil sample with mercury. Knowing the volume of the pan and the

(Continued on page 89)

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*U. S. Bureau of Soils, Bulletin No. 45.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

Founded January, 1892

E. L. POWERS
Editor

T. A. HULBERT
Managing Editor

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Copy for classified and other advertisements where proofs are not required will be accepted until noon on Monday of the week of issue.

Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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Vol. LXI August 17, 1921 No. 7

BAD ROADS CAUSE CROP WASTE IN THE ARGENTINE

The farmers of the Argentine lose approximately one-fourth of their crops each year because the roads are so bad that they can not get their produce to market, according to newspaper reports. As a measure of relief, it is proposed to build a road from Buenos Aires through Rosario to Cordoba, thus opening up one of the richest agricultural sections of the country.

The farmers of this country suffer no such losses through bad roads as do the farmers of Argentina, but they lose enough so that the value of better roads should be evident to every man who gains a livelihood from the farm.

COORDINATING RAILWAYS AND HIGHWAYS IN ENGLAND

Instead of the short-sighted opposition to the development of highway transportation occasionally manifested by American railroad men, the British, according to recent news reports, seem to have recognized the possibility of utilizing the motor vehicle and the highway as adjuncts of their service.

The manager of one of England's leading railroad systems is reported to have suggested to a number of members of the House of Commons that the railway law be so modified as to authorize railroads, not now enjoying such powers, to develop subsidiary motor truck service.

Such coordination is entirely logical and practical. The time may come when both the railway and the highway will be scrapped for some better means of transportation—the airway, for instance—but that time will not be in the near future. Meanwhile both railways and highways together with waterways will be used and the sooner the "trinity of transportation" becomes an acknowledged fact instead of a pretty figure speech, the sooner will goods and passengers be carried with the maximum of economy and efficiency.

Missouri Passes Road Measure After prolonged debate extending over nearly a year, the Missouri Legislature has passed a law providing for the construction of a state system of highways with the $60,000,000 bond issue authorized at the last general election. Governor Hyde has signed the measure. Thus is the way opened for Missouri to "pull herself out of the mud!"

Pennsylvania Makes Road Building Record While many lines of business are going through a painful period of deflation and readjustment in the return to "normalcy," the State of Pennsylvania hangs up what looks like a record in road building by laying 35 miles of hard-surfaced road in a week! This confirms our contention that there is nothing really wrong with the road building game.

An Example of Foolish "Saving" An Arkansas county let one of its bridges fall into disrepair—presumably to "save" money. A while ago a man attempted to drive a mule across the structure, but the mule's weight was too much for the rotten flooring and he went through, injuring himself so badly that he had to be shot. It cost the county $225, enough to have repaired the bridge several times. And now the repairs have got to be made. The Arkansas county is only one of a lot of others.

Advertising a State by Good Roads A well known road builder once characterized the streets of a city as its show windows. A somewhat similar view is held by Charles S. Hill, Commissioner of Immigration of Wyoming, who recently wrote that his state believed that good roads constituted the best medium for advertising its scenic wonders and its utilitarian advantages. His letter to "Good Roads" is quoted elsewhere in this issue. No doubt as to the soundness of his thesis can exist. Scenic wonders mean little to the tourist or productive farms to the settler unless they are accessible by modern means of travel.

The Great Western Gateway

(Concluded from page 83)

Long and tiresome discussions took place among various factions. Some desired the bridge in one place and others in another. At last it was deemed advisable to continue State St., which is Schenectady's main thoroughfare, to the river and build the bridge from that point to Scotia. It virtually spans three streams and two islands and will be 4,436 ft. long. Of this, 1,260 ft. will be in approaches, leaving the length over the water and the islands 3,176 ft. The roadway for vehicles will be 40 ft. wide, with a 6-ft. footpath on either side. The total cost will be approximately $1,753,000. [A brief account of the proposed construction was printed in "Good Roads" of Dec. 8, 1920.—Ed].

The contract for the Schenectady and Scotia approaches was awarded to Du Bois Bennett & Son, and work was started during the summer of 1920. The bank on the Schenectady side is considerably higher than the water level and a long narrow abutment was erected as an approach. The Scotia approach consists of a fill about 1,000 ft. long, the bank being only a few feet above the river level. Material for the fill was obtained from the river bottom by a bucket running on a cableway between a tower near the Scotia approach and an anchorage across the river.

On the two islands crossed by the bridge, 23 pier foundations are being constructed by the American Pipe & Construction Co. The islands consist of alluvial soil and the pier foundations are being placed on 30-ft. oak piles. Stone and cement are brought to the islands on barges, and the concrete is carried to the various piers in cars drawn by gasoline locomotives.

The central arch of the bridge, crossing the Barge Canal, will be 212 ft. long, thus exceeding by 32 ft. the arch span of the Tunkhannock Viaduct. The roadway over this span will be 52.5 ft. above mean water level, giving sufficient clearance for any vessel likely to pass under at any time.

The contracts for the superstructure, including 24 spans and the long center span, and those for paving, lighting, etc., are yet to be awarded.

At this writing the Schenectady approach is nearly finished, except for such minor details as the balustrades and the paving which will not be attempted until 1923. The concrete work on the Scotia approach has been completed and the fill is nearly finished. Several of the pier foundations on Van Slyke Island have been completed and it is hoped that by 1923 the piers and much of the superstructure will be finished so that the balustrades, lighting and paving can be taken care of during the spring and summer of 1923 and the bridge opened to traffic in the late summer or fall of that year.

The new bridge will be the largest in the northeastern part of the state and will be exceeded in length only by the four bridges for vehicular traffic spanning the East River at New York City. And it will be one of the most beautiful as well as most needed bridges in the State of New York.

Another Pittsburgh Bridge Fire

The Point Bridge, Pittsburgh, Pa., was discovered afire three times on the night of July 28. Because of the numerous bridge fires, policemen have been stationed at the 43rd St. Bridge between Pittsburgh and Midvale.

County not Liable for Paint on Woman

Is a county liable when a woman gets on too much paint? County Attorney Butler of Putnam County, Fla., has ruled in the negative, in the case of a woman unexpectedly over-painted by a painter working on one of the county bridges.

Pennsylvania Builds Record Mileage

The State of Pennsylvania laid 35 mi. of hard surfaced roads during the week ending July 28. During the 1921 construction season, up to July 28, the state has built 316 mi. of highways, and contracts awarded this year embrace 308 mi.

Motor Truck Competition Worries British Railroads

Want Enabling Act for Use of Motor Trucks for Subsidiary Service

British railroads wish to develop motor transportation as an adjunct to rail transportation, according to a proposal presented to a meeting of 70 members of the House of Commons by General Harry Thornton, General Manager of the Great Eastern Railway Co.

He explained that he wished a clause added to the railway law empowering railways, not now in such position, to develop subsidiary service by the use of motor trucks. He argued that under the grouping system an impossible situation would arise if some railroads had the power to use road transport while others had not.

This appeal is taken to indicate that the railroads without motor service are worried over the competition of railroads with motor service, realizing that they cannot compete unless they have similar faculties.

For Every Mile of Improved Road in Maryland there are approximately 68 motor vehicles.

The California State Highway Commission let contracts for approximately $6,000,000 during the first six months of this year.

Tests for Soils with Relation to their Use in the Subgrade of Highways

(Continued from page 86)

volume of the mercury required to fill it after contraction of the soil has taken place the percentage of contraction may be calculated. The volume of mercury in the container is controlled by means of a glass plate which is pressed down firmly over the top of the pan, thus squeezing out the excess.

Time of Slaking and Cementing Value

The time required to slake in water may be considered as an indication of the character of the clay content of the soil. The determination is made in the following manner: A mixture consisting of equal parts by weight of soil and powdered quartz, both passing a 200-mesh sieve, is mixed with 20% of water and molded into 25x25-mm. briquettes under a pressure of 130 kg. per square centimeter. The briquettes are then dried in air for 20 hours and in an oven at 100° C. for 4 hours after which they are cooled 20 minutes in a desiccator and tested. For the slaking test, the briquette is placed in a brass ring submerged in water, as shown in Fig. 4, and the time required to slake through the ring is recorded as the slaking time. For the cementing value test, the briquettes are tested in the Page impact machine, in accordance with the method of the Bureau of Public Roads.**

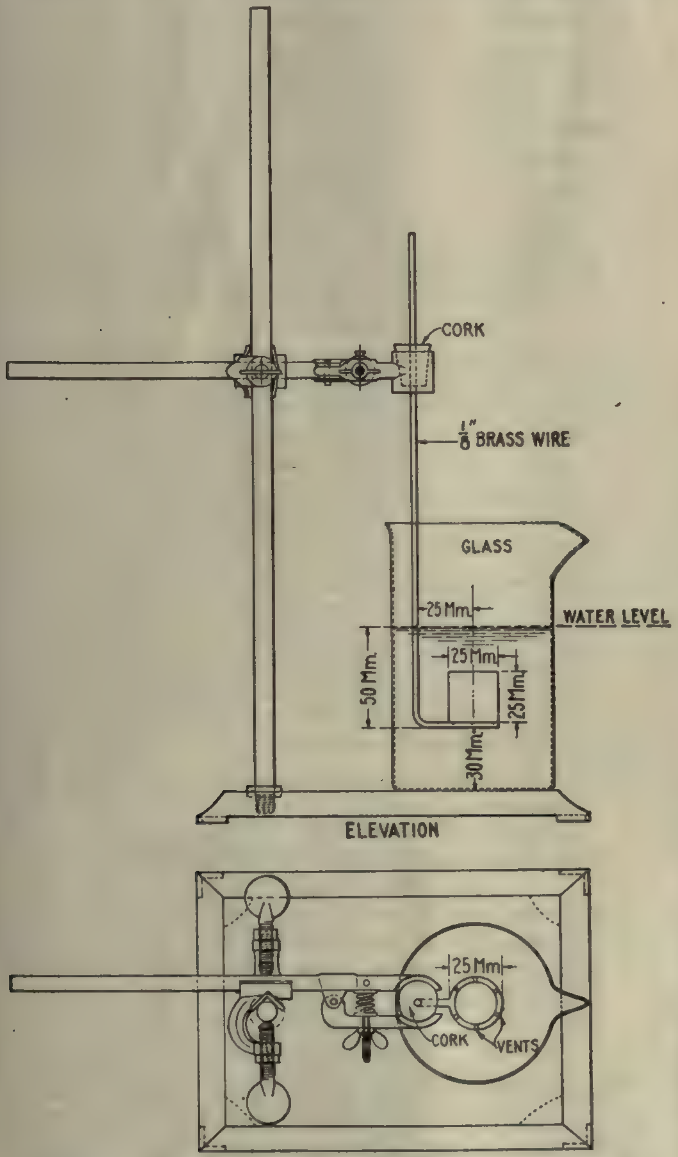

FIG. 4—APPARATUS FOR DETERMINING SLAKING VALUE OF SOILS

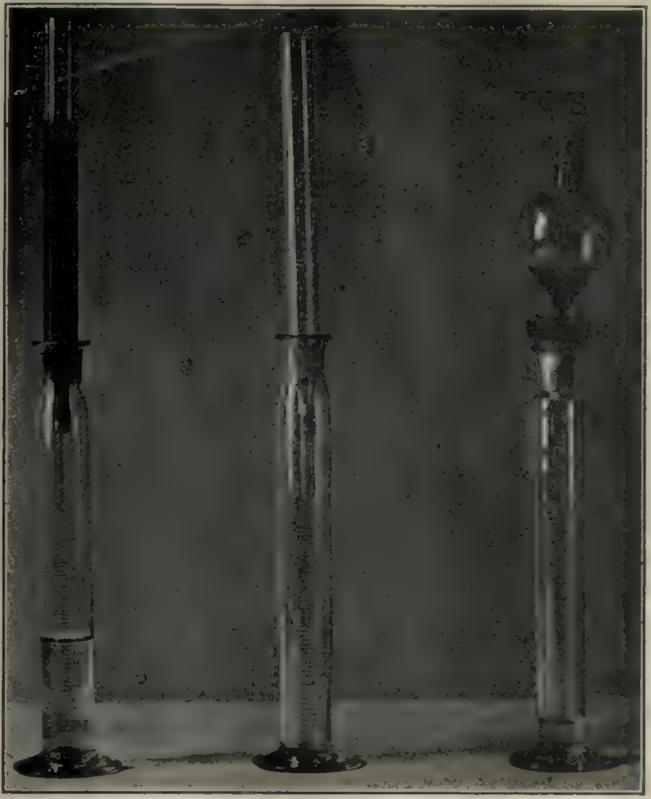

FIG. 5—TUBES USED IN ADSORPTION TEST

Adsorption Test

This test has been developed to determine the adsorptive properties of soils for basic analine dyes as a measure of the colloidal content and plasticity of subgrade road materials. About 20 g. of soil are taken from the sample used in the bearing power test and after passing a 200-mesh screen are brought to constant weight at 100° C. From this sample 0.2 g. are carefully weighed out on a sensitive chemical balance and transferred through a wide neck funnel to a 30-cc. globe-shaped separatory funnel (Fig. 5-A) containing about 2 cc. of the dye solution employed in the test. This solution consists of one part per thousand of commercial methyl violet in distilled water, and a convenient quantity should be made up in advance in order to maintain a constant strength during a large number of tests.

The weighed sample is then shaken up in the separatory until the dye solution is completely decolorized and the material settles down in a flocculated

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**Department of Agriculture, Bulletin No. 347.

condition, when it is run into a filtering tube closed at one end with filter paper (Fig. 5, B) and the funnel washed clean with the dye solution and drained into the tube. This tube should measure about 7 in. by ½ in. inside diameter and be drawn at the lower end for a distance of 1 in. to a stem having a ¼-in. inside diameter and connected by a straight ground glass joint with a short stopper tube. This tube is required to insert the filter paper (disks ⅝ in. in diameter) snugly in place in the narrow ground glass stem of the percolator as well as to assure a uniform rate of flow of the dye solution through the material to be tested and should be filled with water before beginning the test.

The test consists in determining volumetrically the maximum quantity of dye stuff adsorbed by 0.2 g. of clay and is carried out by allowing the dye solution to percolate slowly through the clay into a 25-cc. graduate until a faint coloration appears in the liquid passing the filter paper, when the volume of the filtrate is read off (Fig. 5-C.). This value multiplied by 5 would indicate the number of cubic centimeters of a 1 : 1000 dye solution adsorbed per unit weight of clay and may be termed the adsorption number. This number divided by 10 equals the percentage of dye adsorbed.

In the case of soils having exceptionally low adsorption it will be found desirable to increase the test sample to 0.5 g. The adsorption number is then obtained by multiplying the volume of decolorized solution by 2. In some few instances where exceptionally plastic clays were encountered, a graduate of 50 cc. capacity was required to collect the decolorized solution, and in one instance, 100 cc. passed a 0.2-g. sample before the end point of the reaction was reached.

(To be concluded)

Suggestions to Road Boosters

Four Rules Proposed by the Nebraska Department of Public Works for the Guidance of Those Desiring to Help the State

1. In your own county give proper credit for good roads and proper criticism for bad roads to whom such credit or criticism is due.

2. Encourage the work of the patrolmen in your county. In the end, the success of the maintenance program depends upon the patrolman. Some sort of competition, with a suitable prize, might well be inaugurated.

3. Boost for constructive and kill destructive legislation. In this connection, each commercial club in the state should join, if possible, the Nebraska Good Roads Association and send delegates to the annual meetings. This organization meets prior to the legislative session and the discussion will bring out what is most needed.

4. Help to arrest and prosecute violators of the motor vehicle law. Organize a vigilance committee to look for the violators and for stolen cars. Every dollar collected into the motor vehicle fund goes to the roads. Don't let a man drive a car, who has not paid for a license, as the majority of the citizens in the state have paid.—*"Monthly Report" of the Nebraska Department of Public Works.*

"The Engineer"

The following is credited by "Texaco Tips" to the Texas Blue Print & Supply Co. of San Antonio, Texas.

THE ENGINEER

Who comes with pencil sharpened keen,
With profile long and sober mien,
With transit, level, book and tape,
And glittering axe to swat the stake?
The Engineer.

Who sets level, bends his spine,
Squints through the glass along the line,
Swings both his arms at rapid gate,
Yells "Hold that gol-darned rod up straight?"
The Engineer.

Who raves and snorts like one insane,
Jumps in the air and claws his mane
Whene'er he sees a scraper take
A whack at his most cherished stake?
The Engineer.

Who says he'll charge an even ten
For stakes destroyed by mules and men
While on all fours he tries in vain
To find the vanished stake again?
The Engineer.

Who saws the air with maddened rage
And turns with hate the figured page
And then, with patience out of joint,
Ties another reference point?
The Engineer.

Who calls it your unrivaled gall
Whene'er you kick for overhaul
And gives your spine a frigid chill
Whene'er you spring an extra bill?
The Engineer.

Who deals with figures most profuse
And tells you solid rock is loose,
That hardpan is nothing more than loam,
While gumbo is lighter than seafoam?
The Engineer.

Who, after all, commands our praise,
In spite of his peculiar ways,
While others harvest all the gains
That spring from his prolific brains?
The Engineer.

New York Tunnel Engineers Appointed

Engineers for the proposed tunnel under New York Harbor between Staten Island and Brooklyn have been appointed as follows: Jesse B. Snow, Tunnel Engineer, $12,000; Col. W. J. Wilgus and John F. Sullivan, Consulting Engineers, $10,000 each; Charles B. Drew, Principal Assistant Engineer, $7,500. Mr. Snow is now principal assistant engineer for the New York and New Jersey Tunnel Commission, which is in charge of the building of the vehicular tunnel between New York and New Jersey.

Arkansas County "Economizes" on Bridge

A modern Aesopian moral can be drawn from a recent happening in Johnson County, Arkansas. A man was driving his mule over a bridge with bad flooring and the mule went through, injuring it so that it had to be killed. This cost the county $225, enough, it is said, to have repaired the bridge a dozen times.

Federal Aid Bill Introduced in House

A bill appropriating $100,000,000 for federal aid for the year 1922 has been introduced in the House by Congressman Woodruff of Michigan. The bill provides also $5,000,000 for the next two fiscal years for the construction of roads in national forests. Congressman Woodruff is vigorously opposed to the Townsend Bill which proposes to create a federal highway commission for the construction of a federal system of highways.

Bad Roads in the Argentine Republic

Farmers Lose Quarter of Crops Each Year Because of Poor Roads

Presenting figures to show that, because of its bad roads, the Argentine Republic loses about one-fourth of its crops each year, the director of national roads has presented to Congress a program calling for the construction of 700 km. of macadam roads, 6 m. wide, to connect Buenos Aires with other important cities. Good roads are particularily needed between Buenos Aires and Rosario and Cordoba, traversing the richest agricultural districts of the country. The cost of these proposed roads is estimated at 18,000,000 pesos.

The republic has only dirt roads, impassible for six months out of the year; hence farmers are unable to move much of their crops.

$60,000,000 Road Measure Passes Missouri Legislature

Bonds Will be Used for the Construction of System of Hard Surfaced and Gravel Roads

Both houses of the Missouri Legislature have passed a measure providing for the construction of a state system of hard-surfaced roads with the proceeds of the $60,000,000 bond issue authorized by the voters at the last general election. The vote of the House was 129 to 2 and the vote of the Senate 28 to 0. This action is the culmination of two sessions of the Legislature. The bill provides for the issuance of $10,000,000 of bonds in 1923 and $5,000,000 annually thereafter. Motor vehicle fees will be used to retire the bonds.

The system of highways to be constructed will consist of approximately 7,000 mi., of which 1,500 mi. are to be constructed of higher types of pavement. Approximately one-half of the bond issue will be used for higher type pavements and one-half for gravel roads. It is further provided in the bill that one-third of any federal funds received shall be used for road construction of higher type than gravel and the remainder for gravel roads.

A highway commision consisting of four members will be created. It is expected that this commission will be appointed shortly and an engineering organization built up by the end of the year.

Wyoming Believes in Good Roads

The People's Faith in Highway Betterment as an Advertisement of their State Shown by an Overwhelming Vote for a Road Bond Issue

The State of Wyoming believes good roads to be the best advertisement of its scenic wonders, its agricultural possibilities and its mineral resources, according to Commissioner of Immigration Charles S. Hill in a recent letter to "Good Roads." The people registered their approval of that policy at the election on May 10, when by a vote of 5 to 1 they authorized a state road bond issue of $1,800,000.

"It is my firm belief," Commissioner Hill writes, "that a continuation of the present policy of giving Wyoming the best possible roads will increase its population faster than any other agency and will open up to capital for development the greatest mineral deposits of all kinds to be found in America.

"This state has undoubtedly the largest known coal deposits, phosphate rock, asbestos and mica, and numerous other minerals, of any state in the union.

"Our highways are maintained throughout the year, and they afford to the tourist and the investor a splendid opportunity to combine pleasure with business. Wyoming is perhaps the least advertised of any state, but with the completion of its road program, it will be the Mecca of many hundreds of thousands of tourists in the near future. Due to its roads, the tourist travel last year, and this year during the month of June, through Wyoming to Yellowstone Park has doubled. Every county in Wyoming registered by its vote on May 10 its determination to continue its road building program and put this state on the good roads map of the Unite States."

Atlantic City, N. J., will widen Maine and McKinley Avenues.

More Motorcycles Are in Use in England than all other motor vehicles.

The King of Siam has ordered several canals to be filled and converted into motor roads.

MEETINGS

Calendar of Coming Meetings

Aug. 23-25.—League of Cities of the Third Class in Pennsylvania.—Annual convention, Butler, Pa. Secretary, Fred H. Gates, City Clerk, Wilkesbarre, Pa.

Aug. 24-25.—Custer Battlefield Hiway Association.—Annual convention, Mitchell, S. D. W. D. Fisher, Secretary, Sheridan, Wyo.

Aug. 30-Sept. 1—Michigan State Good Roads Association.—Annual meeting, Flint, Mich. P. T. Colgrove, Pres., Hastings, Mich.

Sept. 7-9.—League of Virginia Municipalities.—Annual convention, Norfolk, Va. Secretary, L. C. Brinson, Portsmouth, Va.

Oct. 12-14.—League of Kansas Municipalities.—Annual convention, Lawrence, Kan. Secretary, John G. Stutz, University of Kansas, Lawrence, Kan.

Oct. 19-20.—North Carolina Good Roads Association.—Annual convention, Greensboro, N. C. Secretary, H. M. Berry, Chapel Hill, N. C.

Oct. 20-21.—Ohio State Conference on City Planning.—Annual conference, Columbus, O. Secretary, Charlotte Rumbold, Cleveland, O.

Oct. 24-28—American Society for Municipal Improvements—Annual Convention, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

American Society of Mechanical Engineers

The Metropolitan Section of the American Society of Mechanical Engineers will hold a meeting in New York City on Sept. 23 to discuss methods of snow removal.

Highway and Highway Transport Education Committee

A meeting of the Highway and Highway Transport Education Committee of the U. S. Bureau of Education was held at the University of Maryland on July 29.

Among the speakers were Prof. W. K. Hatt, of the National Research Council, and Prof. J. G. McKay, of the University of Wisconsin, who spoke upon the need for research in highway economics.

Thomas H. MacDonald, Chief of the U. S. Bureau of Public Roads, pointed out that many states are fast approaching their bonded indebtedness limit and that provision should be made by the states for the raising of the bonding limit so as to carry forward road construction.

Roy D. Chapin, Chairman of the Highways Committee of the National Automobile Chamber of Commerce, spoke upon the development of highway transport in this country, saying that the capital invested in highway transport is now greater than the capital investment of the railroads.

L. M. Estabrook, Assistant Director of the Bureau of Markets and Crop Estimates of the Department of Agriculture, spoke upon the growing importance of the motor vehicle in the moving of crops and the necessity for improved roads to aid the farmers in moving their crops.

PERSONAL MENTION

H. W. Coleman has been appointed city engineer of Albany, Ga.

Edward H. Maier has been appointed city engineer of Bridgeton, N. J.

James Haslett has resigned as assistant city engineer of Sault Ste. Marie, Ont., Canada.

P. C. Painter, City Engineer of Washington, N. C., was recently elected city manager of Greensboro, N. C.

Charles E. Waddell has been appointed chairman of the North Carolina State Board of Registration for Engineers and Surveyors.

Clifford M. Holland, Chief Engineer of the New York and New Jersey Tunnel Commission, has gone to Europe to study vehicular tunnels.

C. F. Convert, formerly Assistant Bridge Engineer with the North Dakota State Highway Department, is now with Black & Griffin, Mandan, N. D.

J. D. Ackenheil, formerly with the Portland Cement Association, has been appointed special representative by the Heltzel Steel Form & Iron Co., Warren, O.

Herman H. Smith has been appointed deputy engineer of the Board of Estimate of New York City at a salary of $8,000. Mr. Smith was appointed assistant engineer of the Brooklyn Bureau of Highways in 1903 and from 1906 to 1910 was engineer in charge of highway maintenance and repair, since that time being chief engineer of the bureau.

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GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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Concrete Roads
must be
reinforced

It is demonstrated beyond doubt that to make concrete roads proof against heavy motor traffic, weather and time a fabric of steel must be incorporated in the concrete.

Several great States have so ruled.

American Steel and Wire
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Fulfills Every Engineering Requirement.

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THE HIGHWAY CONTRACTOR AND ROAD BUILDER

Vol. LXI. NEW YORK, N. Y., AUGUST 24, 1921 Number 8

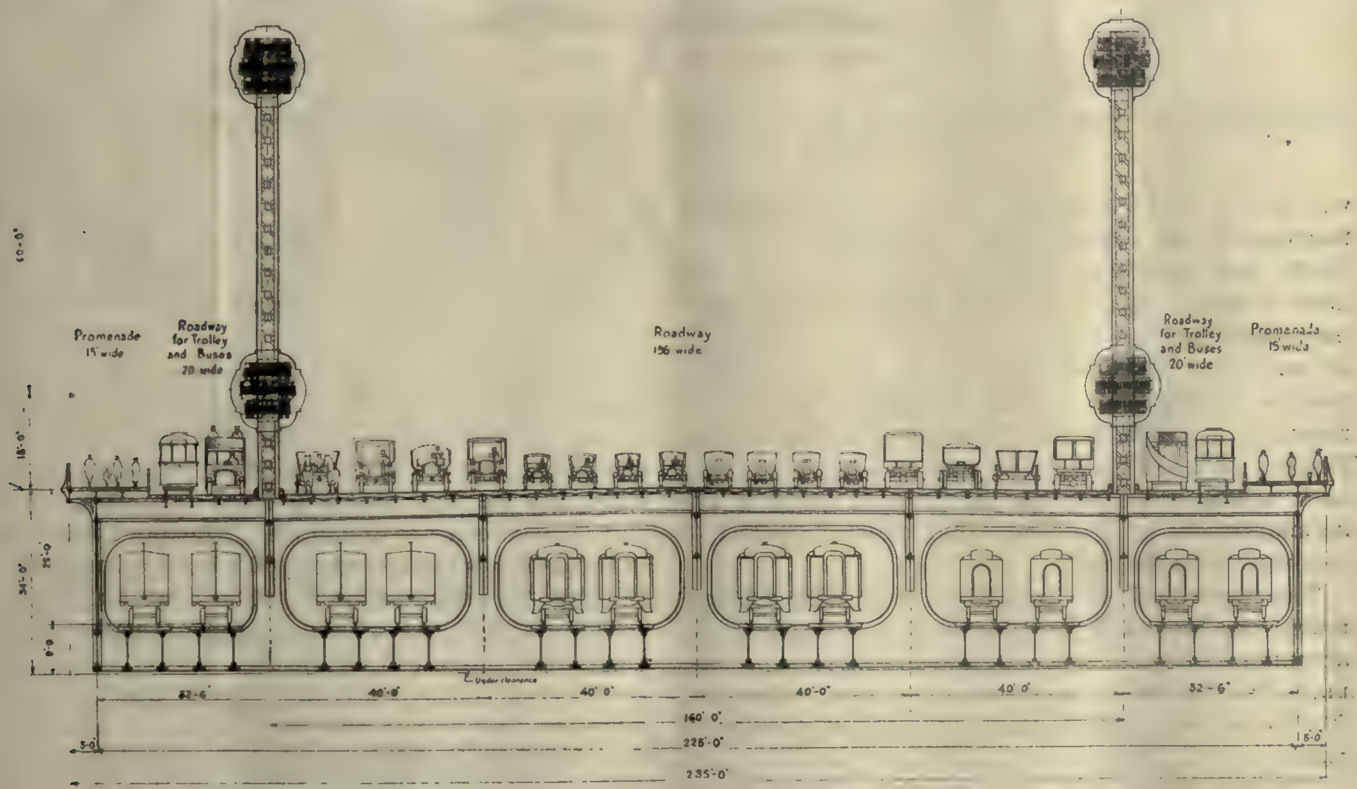
The Proposed Hudson River Bridge

Weatherproof Steel Suspension Bridge with Eyebar Chords will Have Central Span 3,240 ft. Long and Two Shore Spans 1,650 ft. Long — 155-ft. Roadway will Accomodate 16 Lines of Vehicular Traffic

For three decades the idea of a bridge spanning the Hudson River at New York City has smoldered in the minds of imaginative engineers, but because of the stupendousness of the project, Manhattan Island continues to rely on ferries and tugboats for the transportation of passengers and freight to and from the mainland to the west. New York City, the metropolis of America, is more isolated from the country west of it than is a little town on the Erie Railroad.

Toward the close of the last century, Gustav Lindenthal, the famous bridge builder, attempted to promote the construction of a bridge across the Hudson. He had the cooperation of Samuel Rhea, now president of the Pennsylvania Railroad, but other railroads leading into New York did not join in the project and the plan fell through. Later the Pennsylvania tunneled the river.

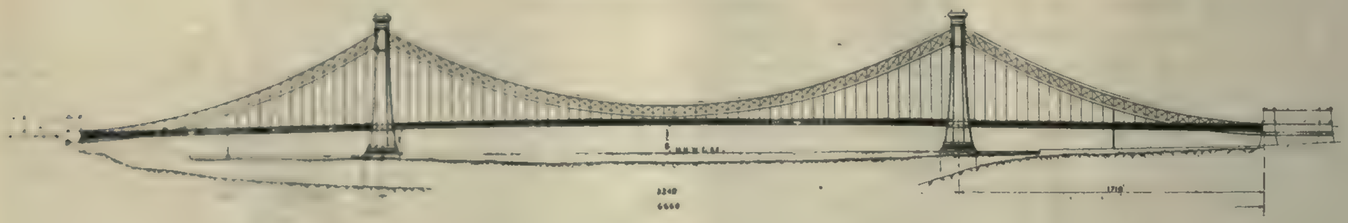
The idea of bridging the Hudson River has been revived by Mr. Lindenthal and a number of prominent men have lined up back of the project. He has designed a structure which will be the greatest



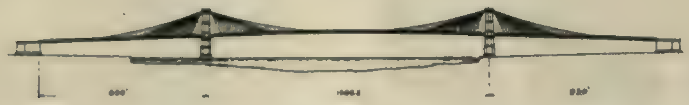
CROSS SECTION OF PROPOSED HUDSON RIVER BRIDGE AT CENTER OF SPAN bridge ever built. The bridge proper will cost approximately $100,000,000 and the terminal facilities on both sides of the river about $115,000,000, making a total of $215,000,000.

The proposed bridge will be constructed over the Hudson River between New York City and Weehawken, N. J., and will have a central span of 3,240 ft. and two shore spans of 1,650 ft. each, a total length, including anchorages, of 7,340 ft. The floor of the bridge will be carried by two suspension arches, each consisting of two chords 60 to 80 ft. apart vertically, with bracing between, thus providing stiffening under passing loads. Instead of wire cables as used largely in former suspension bridges, as the famous Brooklyn Bridge, each chord will consist of three chains formed by eyebars and enclosed in watertight tubular aluminum casting about 15 ft. in diameter. Each chain will be made up of 20 to 30 eyebars, 16 in. wide, strung up side by side and fastened together with pins. Altogether, there will be 12 of such chains carrying the suspended floorway of the bridge. The eyebars will be 60 to 70 ft. long from center to center of pins and will have a tensile strength about twice that of ordinary steel, but not higher than the best alloy steels in use today. Accordingly, in this greatest single feature of the bridge, there is nothing unusual in material or shape, but the idea of grouping a large number of such eyebars in such a simple way for such a long span and the methods of doing it are an adaptation, by Mr. Lindenthal, of an old principle to a very long span.

PROPOSED HUDSON RIVER BRIDGE



BROOKLYN BRIDGE



ELEVATIONS OF THE OLD BROOKLYN BRIDGE AND THE PROPOSED HUDSON RIVER BRIDGE, SHOWING COMPARATIVE SIZES OF THE TWO STRUCTURES

The upper deck will be 220 ft. wide, with a broad motor roadway 155 ft. wide with no obstructions, accommodating 16 lines of traffic. Provision is also made for two trolley tracks and two 15-ft. sidewalks. The lower deck will accomodate 12 lines of railroad track.

The two towers, in order to give the most economical sag to the chains, will be constructed with a height of 800 ft. above water level, with bases measuring 160x400 ft. These towers will be founded on rock, 165 ft. below water level, and will be constructed of steel encased in a shell of masonry. While this masonry shell is used partly for its architectural effect, its principal function it to protect the internal steelwork. Likewise, in the design of other steel elements of the bridge, precaution is taken to protect them from the weather. This is an important feature and will undoubtedly save millions of dollars on maintenance costs. The importance of protecting the steel work from the elements is seen from the fact that it requires a gang of 100 men to keep the Firth of Forth Bridge painted. It takes about four years to paint this bridge and then the gang starts over it again.

About 170 ft. above water level the tower will be pierced by three arches, a central arch 150 ft. wide and 100 ft. high, and two side arches each 35 ft. wide. A Roman arch window 120 ft. wide and 275 ft. high with steel framework and heavy wire glass will be set in the face of the towers. This will give light to the interior steelwork and add to the asthetic effect. The total weight of steel in each tower will be 35,000 tons.

The end anchorages of the bridge will be huge masses of masonry, 400 ft. longitudinally with the bridge, 375 ft. wide and 220 ft. high. On each anchorage will be built two office buildings, 70 ft. wide, 250 ft. long and 280 ft. high. This allows 100 ft. between the buildings. The horizontal pull of the cables is estimated at 260,000 tons, thus necessitating the construction of such huge anchorages.

The clear height of the bridge at center above mean high water will be 150 ft.

While it is impossible to foresee how great an influence this bridge will have upon the Metropolitan District, it will do much to solve many of the transportation problems of Greater New York and

(Concluded on page 98)

Tests for Soils with Relation to Their Use in the Subgrade of Highways---II*

Mechanical Analysis—Water Holding Capacity—Moisture Equivalent—Vertical Capillarity —Air Shrinkage—Time of Slaking and Cementing Value—Adsorption Test— Comparative Bearing Power—Discussion of Results Obtained

By A. T. GOLDBECK and F. H. JACKSON†

(Concluded from August 17)

Comparative Bearing Power

The test which has been developed for determining the comparative bearing power of soils is only of value in so far as it offers a basis of comparison between soils of dissimilar nature. As it is practically impossible to prepare a soil in the laboratory so as to duplicate field conditions, it has been necessary to make the test on samples prepared in an arbitrary way. It is believed, however, that results obtained by this method will assist materially in determining which of the physical properties of the soil are of most significance in determining its value for use as a subgrade material. The method may be briefly described as follows:

The soil prepared as previously described is mixed by hand with just sufficient water to enable it to be thoroughly kneaded and placed in the mold homogeneously. It is then subjected to an initial pressure of 30 lb. per square inch preparatory to making the bearing power test. A tight-fitting plunger is used for this purpose and is removed after the proper compression has been obtained. The apparatus for making the bearing power test consists essentially of a brass cylinder (area 10 sq. in.) securely fastened to the moving head of a 20,000-lb. universal testing machine, a brass ring for confining the soil vertically and insuring perpendicular application of the load, and two 0.001-in. Ames dials, so mounted as to measure the penetration of the brass cylinder with respect to the cylinder containing the soil. A drawing of the apparatus is shown in Fig. 6. Having subjected the soil to the initial pressure desired

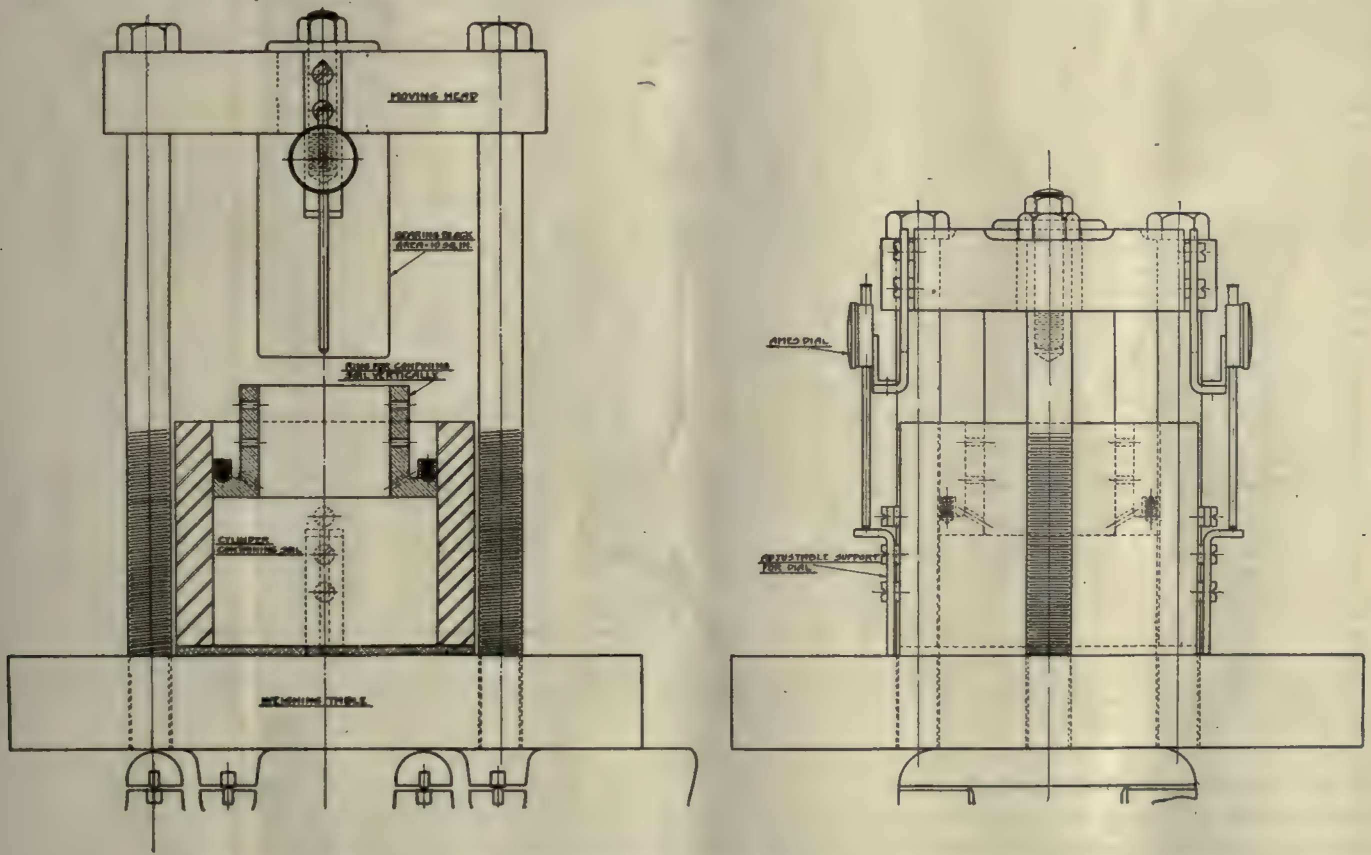

MOVING HEAD
BEARING BLOCK AREA-10 SQ. IN.
RING FOR CONFINING SOIL VERTICALLY
CYLINDER CONTAINING SOIL
WEIGHING TABLE
AMES DIAL
ADJUSTABLE SUPPORT FOR DIAL

FIG. 6.—APPARATUS FOR DETERMINING COMPARATIVE BEARING POWER OF SOILS

the confining ring is clamped in position so as to just touch the soil. The apparatus is then lined up and the head of the machine run down until the brass cylinder is approximately 1/8 in. above the level of the soil. The two Ames dials are then adjusted to bear on the supports which are fastened to the cylinder containing the soil. The head of the machine is now run down at its slowest speed, care being taken to note the instant at which load is indicated by the weighing beam. Simultaneous readings of the dials and load are then taken at increments of 0.005 in. penetration up to 0.05 in. and at increments of 0.01 in. from 0.05 in. up to 0.2 in. This completes the bearing power test for the minimum moisture content and initial compression of 30 lb. per square inch. The soil is then removed from the cylinder, thoroughly kneaded by hand, subjected to 50 lb. initial compression, and the bearing power test made in the above described manner. From the results obtained curves may be plotted showing the comparative bearing power of different soils for different conditions of moisture and initial compression applied. The weight of the soil and its volume before and after compression are also noted and from this information and the specific gravity of the soil, values for density under different conditions of moisture and initial compression are computed.

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*Paper presented at the 24th annual meeting of the American Society for Testing Materials, Asbury Park, N. J., June 21-24, 1921.

†Engineer of Tests, and Senior Assistant Testing Engineer, respectively, U. S. Bureau of Public Roads.

Discussion of Results Obtained

Practically all of the time which it has been possible for the laboratory to devote to this subject has so far been taken up in studying suitable methods of testing. This applies particularly to the problem of designing a satisfactory laboratory test for bearing power. Then, too, the problem of properly preparing samples for test has given some trouble. It has not been possible, therefore, to take up as yet a systematic study of actual subgrade soils, although the tests outlined above have been made on quite a number of such materials. No attempt will be made, therefore, at this time to go into a detailed discussion of results, the purpose of the paper being rather to describe methods of testing. For the purpose of showing the general range in values which have been obtained, a series of results for typical soils from various parts of the country are shown in Table 1. In this table the relative bearing power of the soils is given as the load in pounds required to produce a penetration of 0.1 in. under the conditions of the test and with an initial compression of 50 lb. per square inch. Values for bearing value are given for four moisture conditions: (1) the maximum amount of water which can be worked into the soil, (2) the moisture equivalent, (3) the moisture determined by vertical capillarity and (4) the maximum amount of water which can be worked into the soil.

The determination which apparently yields the greatest amount of information is the test for moisture equivalent. As has been noted, this test is supposed to be an indication of the moisture retentiveness of the soil. Results of tests so far would indicate that, in general, moisture equivalents increase with the percentage of very fine silt and clay in the soil.

(Concluded on page 99)

TABLE I.—TYPICAL RESULTS OF TESTS OF SUBGRADE SOILS.

					Mechanical Analysis									Bearing Power							
					Sand, per cent. Between									Load in lb. at 0.1 in. Penetration							
														(1)		(2)		(3)		(4)	
Soil No.	Locality	Moisture Equivalent	Per cent. Moisture by Capillarity	Water Capacity	10-20	20-50	50-100	100-200	Silt, per cent.	Clay,[1] per cent.	Cementing Value	Time of Slaking	Adsorption Number	Water, per cent.	Load	Water, per cent.	Load	Water, per cent.	Load	Water, per cent.	Load
158	Maryland	2	10	22	27	51	16	3	1	2	....	....	....	0.2	600	2	500	10	250	22	0
29	California	9	34	30	1	41	23	13	13	9	33	6	50	....	....	....	....	....	....	....	....
S. C.	Maryland	10	16	....	19	45	7	3	6	19	14	4	....	4	625	8	500	10	275	....	....
80	Oregon	17	26	41	4	9	9	14	34	30	64	17	45	15	548	17	466	26	34	28	20
56	Missouri	19	33	47	1	3	3	3	69	21	....	....	25	14	420	19	440	33	0	....	....
55	Missouri	19	27	47	3	8	4	4	55	26	82	8	....	16	635	19	780	26	135	47	0
140	Ohio	20	33	44	5	11	5	6	47	26	11	180	....	13	495	20	285	33	0	....	....
9	Pennsylvania	20	29	....	....	1	1	1	58	39	9	4	10	11	445	20	440	29	25	....	....
51	Iowa	22	28	50	5	15	11	12	29	28	134	10	....	18	590	22	245	28	45	50	0
59	Illinois	23	30	55	....	3	5	3	63	26	358	11	80	16	440	23	407	30	35	36	35
50	Iowa	23	36	55	1	8	7	6	44	34	93	8	45	20	565	23	480	36	70	53	0
33	Minnesota	25	33	76	1	2	2	1	59	35	64	.4	180	20	415	25	230	33	30	69	0
62	Illinois	25	30	53	5	17	8	6	24	40	132	14	55	22	530	25	440	30	225	52	0
63	Illinois	25	25	63	1	4	4	2	58	31	144	7	55	20	580	25	530	29	205	41	20
61	Illinois	26	32	56	1	11	7	5	18	58	46	31	75	22	500	26	515	32	200	43	20
70	Oregon	26	29	54	1	6	4	2	44	43	29	5	45	21	565	26	148	29	83	35	11
78	Oregon.	26	31	50	2	15	17	21	28	18	51	6	45	20	525	27	465	31	329	43	30
89	California	29	42	....	....	....	....	....	....	....	470	13	....	18	713	22	686	29	205	39	68
67	Oregon	32	36	75	2	6	6	11	42	33	174	7	130	23	470	28	440	33	212	41	50
82	Oregon	33	33	55	....	2	2	4	55	37	83	6	60	24	540	32	110	39	45	41	15
91	California	34	44	71	2	2	4	15	38	38	370	10	10	25	410	34	175	44	45	71	0
73	Oregon	41	43	75	....	4	8	10	21	57	273	20	140	37	525	40	540	43	300	64	10

[1] The term "clay" as used in this table refers to the fraction removed by 8 min. sedimentation. It is in reality a mixture of very fine silt and clay.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

Founded January, 1892

E. L. POWERS
Editor

T. A. HULBERT
Managing Editor

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Cable Address: Gudrodes, New York

Copy for advertisements must reach the New York office by noon on Tuesday of the week before date of issue if proofs are to be submitted.

Copy for classified and other advertisements where proofs are not required will be accepted until noon on Monday of the week of issue.

Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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Vol. LXI August 24, 1921 No. 8

THE HUDSON RIVER BRIDGE

No matter what the opinion of American science held by a European circumlocutionist recently widely acclaimed in this country, no one can deny that the United States excels the world in the practical application of science. We are a nation of pragmatists rather than a nation of metaphysicists. Our engineering achievements overshadow the work of all nations. Even in highway engineering, to which we turned our attention but a decade ago, we are now leading the world.

Plans have been prepared by Gustav Lindenthal, the famous bridge builder, for a suspension bridge over the Hudson River at New York City with a central span 3,240 ft. and two shore spans each 1,650 ft. in length, as described elsewhere in this issue. The construction of this bridge will be another forward stride in the advancement of engineering in this country.

Two features of the design of this bridge mark a new departure in bridge engineering. First, instead of using wire cables as in former suspension bridge practice, the design calls for chords made up of eyebars of high tensile strength. This idea of grouping together such a large number of eyebars in a comparatively simple manner is the adaptation of an old principle to a long span by Mr. Lindenthal. Second, the design is such that practically all the steel elements are protected from the weather, which, it is estimated, would effect a saving of several hundred thousand dollars annually in maintenance costs.

The proposed Hudson River Bridge will accommodate 16 lines of vehicular and 12 lines of railroad traffic, thus overcoming in a single stroke the greatest problem of New York City, the transportation of passengers and freight to and from the mainland to the west.

TESTS OF SUBGRADE SOILS

With heavier and heavier loads and more and more costly pavements the load bearing power of subgrades becomes of vital importance.

This is generally recognized and road engineers are beginning to take it into account in design. The Bureau of Public Roads has devoted much of its effort to the devising of testing apparatus and the development of testing methods along that line, some of the work of its engineers being described in the paper of Messrs. Goldbeck and Jackson, the second installment of which is printed on other pages of this issue. The testing engineers of the Illinois Division of Highways are also working along similar lines.

While all the work is too new to have resulted in the development of tests that can be applied readily to all work, it is to be expected that in the not far distant future the efforts of the technicians will bear fruit in methods and apparatus that can be applied in practice and that the testing of subgrades will be the rule rather than the exception in the building of roads.

Toll Roads and Bridges A toll bridge across the Delaware River was recently purchased by the States of Pennsylvania and New Jersey. Tolls for crossing the river at this point, the means of egress from northern New Jersey into Pennsylvania, have been collected for over 100 years. Toll roads and bridges are fast becoming shadows of the past—lingering here and there, atavisms in the new order of highway transportation.

Overloading of Motor Trucks The States of Massachusetts and Maine have taken steps to stop the overloading of motor trucks, a practice which shortens the life of both road and vehicle. While most truck operators are cognizant of this fact, there are some who persist in overloading their vehicles. To this latter class arguments about conserving their trucks and roads are of no avail; they can be made to see reason only by the enforcement of strong laws.

Road Patrol System Effective Grant County, Washington, maintains its gravel roads by the patrol system so that they are the best maintained gravel roads in the state, according to the U. S. Bureau of Public Roads. The annual cost per mile is but $223—surely a small price for a good road. In road work, as in other things, "an ounce of prevention is worth a pound of cure." A gravel road properly maintained is often better than a higher type of road whose maintenance is neglected.

The Proposed Hudson River Bridge

(Concluded from page 94)

its environs. The passage of motor trucks and passenger automobiles from New York to New Jersey by ferry often takes hours. With this bridge passengers and freight can be brought by the railroads directly into New York City, thus reducing cost and relieving terminal congestion. Traffic conditions have become such that unless this bridge or a number of vehicular tunnels are built immediately, the commercial life of the city will be stunted.

The Hudson River Bridge will accommodate 500,000 passengers, 12,000 vehicles and 40,000 tons of freight by rail and truck per hour. This is equal to 20 tunnels similar to the vehicular tunnel now under construction. Twenty tunnels would cost more than twice the amount of the bridge and would take longer to build. Also ventilating plants must be constructed for tunnels and the problems connected with the ventilation of such large tunnels carrying motor traffic are extremely difficult to solve.

Townsend's Commission Plan Stricken from Road Bill by Senate

Fight Against Commission Plan Results in Its Defeat in Senate

That the administration of federal aid under the U. S. Bureau of Public Roads is satisfactory is seen by the action of the Senate last week in passing the amended Townsend Bill, after striking out the provision for a federal highway commission. The house is greatly opposed to the creation of a federal highway commision and some time ago passed the Dowell Bill, which provides for the continuation of federal aid administration under the Bureau of Public Roads.

The Townsend Bill, as amended, contains practically all the important provisions of the Dowell Bill. The states are to designate highway systems of not more than 7% of the highways in the state for federal aid. Three-sevenths of the roads included in the 7% are to be designated as interstate roads and the other four-sevenths are to be intercountry roads connecting with interstate roads. It is further provided that 60% of federal aid funds are to be expended on interstate highways. An appropriation of $75,000,000 is carried for the current year.

During the Senate debate the commission plan was stricken out of the bill. Some objection was also raised to the expending of 60% of federal aid on interstate highways, but this provision was left in the measure.

Plant Black Walnuts Along Roads

Last year 30 bu. of black walnuts from trees at the home of George Washington at Mt. Vernon, Va., were sent to W. S. Linton, President of the Northern Nut Growers' Association, and distributed among the children of Saginaw County, Michigan. The children wanted the nuts on school grounds and along public roads and streets.

During the war heavy inroads were made on the available supply of black walnut timber. In accordance with suggestions of the U. S. Department of Agriculture, black walnuts are being planted in small numbers by many persons in various sections of the country.

Hoover Urges Road Building

Immediate Activity in Highway Work Best Way to Relieve Unemployment, According to Secretary of Commerce

An appeal to take up immediately road construction and repair as a means of relieving the present unemployment situation has been addressed to the governors of all the states by Secretary of Commerce Herbert Hoover.

The number of unemployed in the country is estimated at 5,000,000 by the Department of Labor, and Secretary Hoover is of the opinion that immediate activity in road work in the various states would go far towards remedying the condition.

Some time ago, as was noted in "Good Roads," for August 10, Secretary Hoover urged fall letting of road contracts as a means to the same end.

Asphalt Production Increases

The quantity of native asphalt and native bitumens sold in the United States in 1920 was 198,497 short tons, valued at $1,213,908, according to the U. S. Geogological Survey. This was an increase of 125% in quantity and of about 78% in value over 1919.

The sales of manufactured asphalt obtained from domestic petroleum amounted to 700,496 short tons, valued at $11,985,457, or $17.11 a ton. Compared with 1919 these figures indicate an increase of 14% in quantity and 37% in value.

The sales of asphalt manufactured in the United States from Mexican petroleum in 1920 amounted to 1,045,779 short tons, valued at $14,272,862, or $13.65 a ton. This was an increase of 55% in quantity and of 85% in value over 1919.

◆

The State of Wisconsin constructed 53 mi. of road during the month of June and plans to complete 324 mi. during the present year.

New Jersey Bridge and Tunnel Bonds recently issued bear engravings of the late John A. Roebling and the Brooklyn Bridge, which he designed.

Tests for Soils with Relation to Their Use in the Subgrade of Highways

(Continued from page 96)

It has been possible, in fact, to work out an empirical formula which indicates a fairly definite relation between the moisture equivalent and mechanical analysis. There are sufficient exceptions, however, to indicate that certain other factors, possibly percentage of loam, etc., influence this relation.

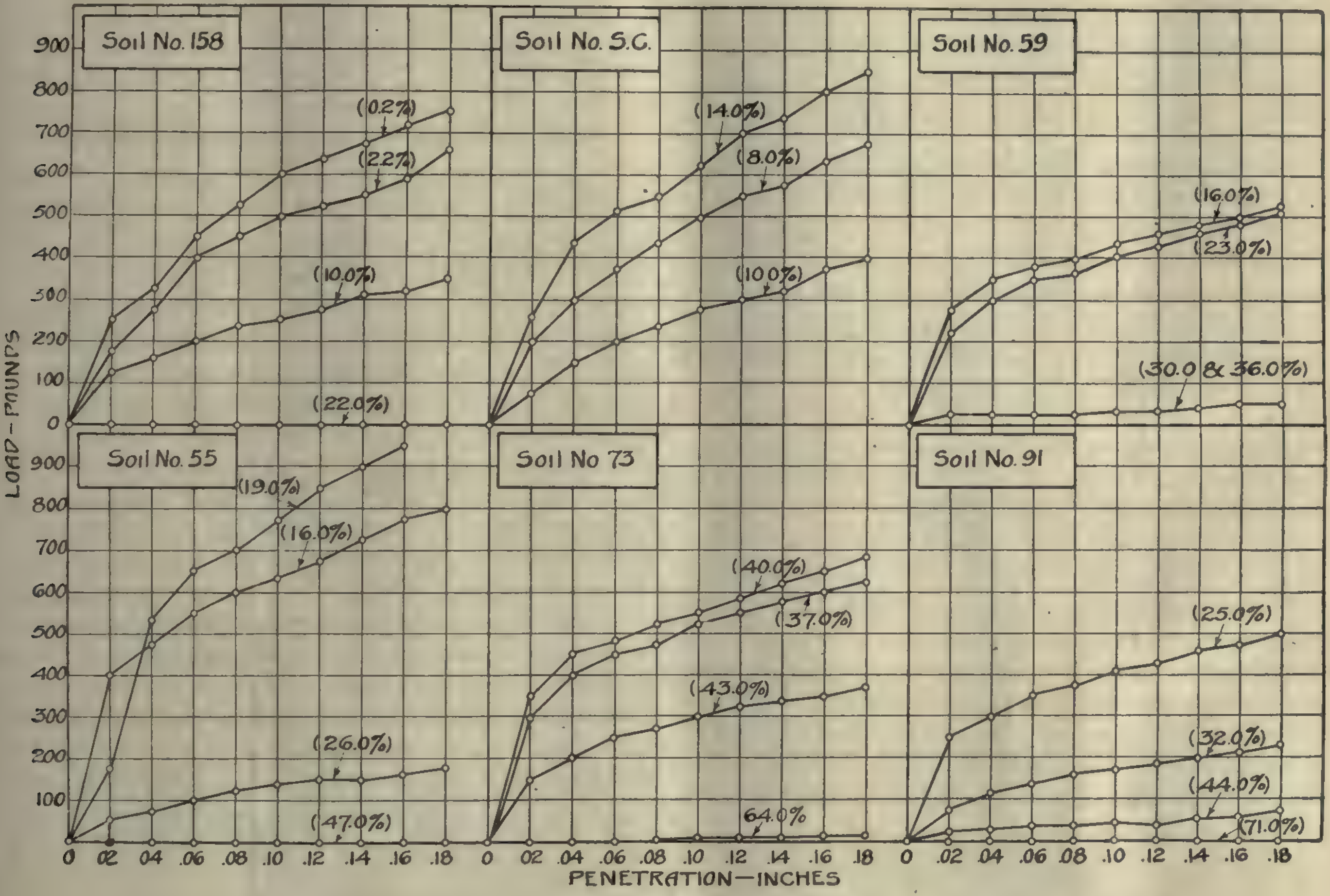

FIG. 7.—CURVES SHOWING RELATIVE POWERS OF SOILS—PERCENTAGE OF WATER USED IN EACH CASE AS INDICATED

Results of the tests would indicate also that the bearing power of most soils in not appreciably reduced by the addition of moisture up to the moisture equivalent. , This apparently applies moreover to all types of soils from pure sand to heavy clays. When the soils become saturated beyond the moisture equivalent, however, a rapid reduction in bearing power apparently takes place, usually disappearing completely at or before the water holding capacity of the soil has been reached. These general comments are given here simply to indicate possible existing relations, and are in no sense definite conclusions, which manifestly can not be drawn without much additional study.

For purposes of illustration there have been plotted in Fig. 7 the results of a number of typical bearing power tests. These tests indicate in a general way the range in values obtained, as well as the influence of moisture on the bearing power.

In conclusion, the authors would emphasize the fact that the study of subgrade soils is a very important subject, upon the successful conclusion of which is involved economy in road construction. It seems apparent that much time and thought will be required before definite conclusions can be drawn. The authors present the above outline of test methods in the hope that others may be induced to take up the subject, devoting to it the time and attention warranted by its importance.

Delaware River Toll Bridge Freed

The bridge over the Delaware River between Easton, Pa., and Phillipsburg, N. J., has been purchased by the States of Pennsylvania and New Jersey for $300,000. Collection of tolls ceased on Aug. 3.

Maine to Curb Overloading

The Maine State Highway Department has started a campaign against the operation of trucks weighing more than the maximum legal weight of 18,000 lb. Inspectors have been sent to various sections with loadometers and when trucks are found weighing over 18,000 lb., the excess load is removed.

Massachssetts Fights Overloading

A campaign has been inaugurated by the Massachusetts Department of Public Works against the overloading of motor trucks. Loadometers have been supplied to inspectors and trucks suspected of being overloaded are stopped and weighed. The maximum total weight of a truck permitted in Massachusetts is 14 tons, with not more than 800 lb. on each inch of tire width.

Ohio to Mark Highways

All state highways in Ohio will be plainly marked next year, according to Leon C. Herrick, State Director of Highways. State roads running north and south will be marked by red bands on telephone poles and roads running east and west will be marked by blue bands. Roads running diagonally will have yellow bands. The Lincoln Highway and similar interstate routes will have distinctive bands.

Bridges Would Not Close Because of Expansion by Heat

Two steel bridges near Newark, N. J., were unable to have their draw spans closed on July 19 because of expansion by heat. These bridges were opened shortly after 4 p.m. One bridge, on the Lincoln Highway, carries trolley and vehicular traffic and was closed after workmen cut off considerable metal with acetylene torches. The other bridge was open until after midnight.

Pennsylvania Spends $17,000,000 on Secondary Roads

During the year 1921 second-class townships of Pennsylvania will have spent $17,000,000 for road work, according to figures compiled from reports made to the Pennsylvania State Highway Department. This work is exclusive of construction in which the state or county participates. Last year second-class townships spent $14,840,000 on road work, involving construction and maintenance of lower types of highways.

Two Division Offices Moved by West Virginia State Road Department

Headquarters of the First Division of the West Virginia State Highway Department have been moved from Charleston to Fayetteville, and J. K. McGrath, formerly County Engineer of Fayette County, succeeds George H. Hill as chief of the division. The Fifth Division headquarters have been moved from Keyser to Martinsburg, with B. E. Gray, former Senior Highway Engineer of the Bureau of Public Roads, as chief of the division.

Immense Holiday Traffic in New Jersey

Traffic counts taken on July 2, 3 and 4 at the intersection of Routes 3 and 4, at Absecon, N. J., show a total of 19,592 motor vehicles passing this point. Traffic counts taken during the same period on Route 1, at Rahway, N. J., show a total of 35,487 motor vehicles passing. Of the vehicles counted at Absecon, 60% were vehicles registered in other states.

Mica in Road Makes Unusual Problem

A road in North Carolina, extending out from Spruce Pine across the Lost Provinces region, presents a difficult engineering problem because the soil contains in some places nearly 50% of weathered mica. In wet weather the road is like axle grease and in dry weather like a feather bed. The State Highway Commission planned to pave this section of road, but is now wondering just how to do it.

New Highway Problem in Ohio

State Highway Commissioner Herrick of Ohio recently ruled that he has no jurisdiction over cimex lectularii in the offices of the department in the old Hartman Hotel in Columbus. This decision was made in reply to a complaint by stenographers that their efficiency is lessened because this troublesome Hexapoda get caught under the keys, gumming them up. The evidence accompanying the complaint reposes, at this writing, in a bottle on the commissioner's desk. The complaint was referred to the state fire marshal, who has jurisdiction over hotels and bedbugs.

Better Bridges Wanted in Kansas

Whether the type of roads being built with federal aid in Kansas prove to be lasting or not, there is little or no excuse for slighting in any quarter the bridges and culverts that are parts of such road projects.

There should be no cheapening of these structures. When built at all they should be substantial and permanent—good for a hundred years and strong enough to withstand the heaviest possible traffic. It is noticeable that the township and county officers of one county will take pains to make their bridge and culvert work the very best, while the adjoining county skimps its bridge and culvert work to the very limit of just getting by the initial inspection.

Modern science has given the formula for the most acceptable type and strength of permanent crossings and drains and it should be adhered to, if not exceeded, in quality of material and strength, even though fewer be built each year.— *The Kansas Official.*

No Misuse of Surplus War Equipment

Replying to persistent allegations from certain quarters that surplus war equipment distributed to the states for road building was being sold or diverted to other uses, Thomas H. MacDonald, Chief of the U. S. Bureau of Public Roads, stated recently that investigations of the bureau disaproved such allegations. State Highway Departments have been greatly aided in their work by the receipt of surplus equipment and have not disposed of any unless it was no longer serviceable for highway work.

May Name New Jersey Roads After Prominent Citizens

Governor Edwards of New Jersey, in a letter to the State Highway Commission, has suggested that the main roads of the state highway system be named after men "who have contributed their ability toward the building up of our magnificent road system, or after men of historical prominence in the state." Among the men mentioned by the governor after whom some of the highways might be named are: the late H. I. Budd, State Highway Commissioner, 1895-1905; the late Col. E. A. Stevens, State Highway Commissioner, 1911-1917; the late Geo. E. Blakeslee, and Senator Edge.

Patrol System of Road Maintenance in Grant County, Washington

Bureau of Public Roads Holds up Gravel Roads of Grant County as Finest in State

The road patrol system used in Grant County, Washington, is pointed out by the U. S. Bureau of Public Roads as an illustration of how highways can be maintained most successfully and economically. Other counties in the state use the "gang" system, assigning to each gang a long section, upon which they make repairs at intervals, seldom reaching all the necessary points. In Grant County the plan is to prevent a road from getting into bad condition rather than to make repairs.

There are 13 patrol sections, each from 6 to 10 mi. long, in the 87.83 mi. of county highways. Each section is in charge of a patrolman, who works constantly on his piece of road, feeling that he alone is responsible for its condition. While these men work under the direction of the county engineer, the details are left largely to their judgment.

A specially constructed light road machine, called locally a "road fixer," is used. It has a long wheel base and two cutting blades rigidly connected with the carrying frame of the machine. The rear wheels are on separate axles, controlled by separate levers. The patrolman carries the necessary small tools for clearing weeds, trimming shoulders, cleaning ditches, and for handing surfacing material. He makes his own repairs in the county repair shop under the direction of a skilled mechanic.

The annual cost of this system, states the Bureau of Public Roads, averages $223 a mile, which is less than other counties pay where roads receive attention "only when they need it." Grant County has gravel roads second to none in the state, and its people are enthusiastic supporters of the patrol system.

Road Problems in Western States Caused by Heay Rains

Methods Used in Nevada and Utah to Save Roads from Damage by Cloudbursts

During July and August, cloud-bursts which are practically very heavy thunder-storms, caused serious problems in road construction in Nevada and Utah. The Bureau of Public Roads has worked out several effective methods of protecting roads from these immense sudden flows of water after long dry spells. Where the drainage channels are well defined no great difficulty is involved in the design of the road drainage structures, but where the flood spreads out over a delta or a valley it is a problem to so locate the line and drainage structures that the latter will save the road from destruction.

In sections where the flood tends to spread out, a wide berm on each side of the roadway makes a substantial protection. The borrow pit provides material for the embankment and serves as a diversion drain. Sometimes a short concrete dip is used for the purpose of passing the water over the road in a comparatively wide and shallow flow instead of under it. A dip is simply a pavement extending the full width of the roadway and protected at each edge against undermining by a cut-off wall extending 18 in. below the bottom of the pavement. Instead of attempting to build up a grade for this pavement, so as to raise it above the flood water, the dip follows the grade of the wash, and the water passes over it in time of flood. Where the deltas are so wide and the country so undeveloped as to make the cost of a concrete dip excessive, the dips are surfaced with gravel and the downstream edge is protected by a concrete cut-off wall. In connection with these drainage dips a V-shaped system of dikes and ditches is used, converging toward the road if it is desired to lead the flow from two or more washes to a single dip, and diverging toward the road when it is better to split the flow of a single stream to more than one dip.

New Hampshire Good Roads Association

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The City of Manchester is being sued for $90,044.16 by Leo. B. Reilly, a consulting engineer of Boston. The money is claimed to be due on account of services rendered in connection with the design and plans for the construction of the Amoskeag and McElwain bridges.

Mayor Moise Verrette has issued the following statement explaining the matter:

"To the Citizens of Manchester: The contract with Mr. Leo Bayles Reilly was made in the regular course of business, after it had originated with what was then the Department of Public Works. It was approved fully by the director at that time and was for bridges greatly needed for immediate use.

"The same routine was followed as was used in the making of the contract for the culvert over Cemetery Brook about that time, which contract has been completed in part at a cost of some $25,000. It was the routine duty of the director of public works to make contracts as needed and for the mayor to approve or disapprove them.

"I regret that the commissions claiming authority over the acts of the city government of Manchester, did not, either by negotiations with Mr. Reilly or by some judicial process, clear the way for either a full recognition of the city's contract with Mr. Reilly or for a cancellation which would be universally recognized as a final determination of the controversy over the Reilly contract.

"I am unable to do more or less, with good conscience, amid the confusion incident to the imposition upon the city of commissions not elected by the people, than to exercise in good faith the powers and duties devolving upon me by virtue of my election by the people of this city as Mayor of Manchester. The difficulties and litigations which exist are not due to any failure on the part of the city government to perform its duties."

The City of Manchester will vigorously oppose the suit for alleged damages of $90,044.16 brought against the city recently by Leo B. Reilly, consulting engineer of Boston, according to a statement made by James B. Wellman, Chairman of the Highway Commission.

"We believe we adopted the proper course of procedure last winter when we decided to follow our own ideas when we came into office," was the comment of Chairman Wellman.

"We know that we saved the city a very large amount of money and that ought to be sufficient justification of our action. Naturally we shall oppose the present suit."

It is pointed out that the present highway commission had nothing to do with the signing of the Reilly contract. The contract was consummated before the highway commission had been created by the Legislature. When the members of the commission assumed office a few days later they examined the contract and came to the conclusion that the best interests of the city compelled its rejection.

As a result of the rejection, it is pointed out, the city saved approximately $300,000. The new Amoskeag Bridge now being constructed is estimated to cost not more than $150,000, compared with an estimated expenditure called for by the Reilly contract of $468,880.

The New Hampshire State Highway Department is also constructing a section of the road from Lake Sunapee Station to the nearby town line. This road is being regraded in several spots and is of gravel with Telford base.

A. E. Badger and Sons of Portsmouth are constructing a 1.5-mi. section of the state highway between Portsmouth and Dover just beyond the Kittery Point Toll Bridge. Construction is of modified Topeka asphalt.

The bridge over the Merrimack River in the Town of Merrimack on the Daniel Webster Highway is being rebuilt by the State Highway Department.

The total rainfall in New Hampshire during July amounted to 4.58 in. and serious damage resulted to many roads. The storm of July 28 was the most destructive and there were occasional washouts requiring as much as 75 double loads of crushed stone to fill them. There was also exceptionally heavy loss throughout the state on account of damage from lightning, many barns being destroyed. The total damage from this storm was estimated as over $75,000.

There have so far been four deaths in connection with the construction of the Memorial Bridge at Portsmouth, among whom were John Beasley, of Portsmouth, and James Cooper, of Dover. Many other workmen have been seriously affected by the work, there being many cases of bleeding from the nose and ears but no other accidents for days were reported. It is claimed that the nature of the work permits but a four hour working day, the men working two shifts of two hours each and receiving pay at the rate of $2.50 per hour. The total crew numbers 50.

Massachusetts Highway Association

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Announcement

This section of the paper is open to members of the Massachusetts Highway Association for the discussion of matters directly connected with road interests. Members are requested to submit items of interest for use in this column.

Address all communications to GOOD ROADS, P. O. Box 2705, Boston.

The quarterly meeting of the Massachusetts Highway Association was held at Plymouth, Mass., Thursday, August 11, about 25 members being present at the dinner held at the Plymouth Tavern.

Some of the members went by train or boat, but the majority of them motored over the cape road, by way of the shore route through Cohasset, or through East Braintree and Hanover.

On account of the small attendance no business meeting was held and speaking was dispensed with. After dinner the members visited the scene of the pageant and other points of interest, returning at an early hour.

The committee of arrangements will report later on the next meeting place.

News and Gossip

Automobilists will be much interested in the new roadway that the City of Boston is to build through Franklin Park, thus affording a good route from Forest Hills St. to Blue Hill Ave. This improvement has long been needed but now is made possible through the City Council setting apart the money from the Parkman Fund. An existing road from which motor vehicles are excluded will be resurfaced and otherwise improved for this purpose from Forest Hills to Columbia Road.

A permanent bridge of steel for the Public Garden, to replace the present wooden bridge, new equipment at the reservation at City Point, abandonment of the old plan for sunken gardens in the Fens and adoption of a new development scheme and other changes are contemplated in the parks in different parts of the city.

The State Department of Public Works reports that going south from Boston to points on the Cape, all of the routes are in good condition after passing Quincy and Hingham. Because of construction in those places, the route through Cohasset is the best one at present, although a little longer. In the vicinity of Plymouth, roads are in good condition in every direction.

At Green Harbor there is a pleasant optional detour, resurfacing of which has recently been completed. This takes the motorist past the houses of Daniel Webster and Governor Winslow, the latter having been restored to its original condition.

On the Cape, highways everywhere are in excellent condition, there being no construction work which interferes with touring. At Provincetown a cut-off has recently been completed at the southern end of the town, making it no longer necessary to use the narrow and dangerous entrance.

The Mohawk Trail is in good condition except for a detour in Gardner, where the town is reconstructing its streets. Only minor reconstruction work is to be encountered at other points along this route.

Between Worcester and Springfield, on the main route, there is considerable work in progress. This includes a new road around the big hill in Leicester, a project which is nearly completed. There is minor construction work under way in Spencer, while between East Brookfield and Palmer there are two extensive projects, where traffic is being controlled by patrolmen in uniform. No detours are necessary on this route, telephones at either end of the construction projects being used in controlling traffic and permitting it to flow alternately east and west.

West of Springfield the Jacob's Ladder route is in good condition, but because of its usually crowded condition it is not recommended as a route of pleasure for week-end tourists.

The following is a schedule of the various types of pavements in the city of Boston.

Total length of the 2,443 paved streets, February 1, 1920, 603.71 mi.; total area 11,391,742 sq. yd., or

8.45% of the city's total land area. This is exclusive of the private streets (not accepted), numbering about 2,840. Of the city's pavements, 369.90 mi. or 62.93% are paved with macadam (including 113.22 mi. bituminous macadam); 104.69 mi. with granite blocks; 41.40 mi. with asphalt; 32.13 mi. with gravel; 23.65 mi. with bitulithic; 10.66 mi. with wood block; 5.46 mi. with brick. Old macadam pavement is gradually being replaced with more satisfactory and durable kinds, such as bitulithic, concrete, granite block, etc.

The 18 principal thoroughfares and traffic routes selected by the Mayor's committee of citizens in 1918 as in urgent need of repair have mostly been resurfaced with granite block, the original estimate of cost being $1,506,200.

New highway construction ordered for 1917-19 and mostly completed includes 29 streets in Dorchester; 25 in West Roxbury; 12 in Roxbury; 14 in Brighton; 6 in East Boston; 2 in Hyde Park and 2 in South Boston; pavement being of bitulithic or asphalt surface on concrete, and bituminous macadam. Gross debt outstanding February 1, 1920, for all street construction, including damages, amounted to $21,608,521, or $369,990 less than in 1919.

The Holbrook, Cabot & Rollins Corporation has brought suit in the Suffolk Superior Court against the Morris & Cummings Dredging Co., of New York, for alleged breach of contract in connection with the construction of the Commonwealth drydock in South Boston. The sum of $100,000 is sought as damages. It is claimed that the dredging and filling contracted for by the defendant was neither completed on time nor performed as required by the contract. The dredging company, in its answer, makes a general denial.

The City of Malden recently purchased a 5-ton truck with dump body.

The Town of Stoneham is constructing a section of Pond St. north of Middlesex Fells Reservation with bituminous macadam.

Work on the new drawbridge over Plum Island River was started July 30, when Gen. Clarence R. Edwards, representing the War Department, turned the first shovelful of earth. The contract was awarded by the Essex County Commissioners. About 500 guests were present, including many state and county officials and several from the Federal Government.

Following the ceremony, a clambake and dancing were enjoyed at the island pavilion. Speeches were made by Senator Carl C. Emery of Newburyport, who also acted as chairman of the committee of arrangements; W. W. Lufkin, Collector of the Port of Boston; Gen Edwards; Congressman George H. Tinkham, of Boston, and former Representative John Thomas, of Gloucester.

The City of Salem has reconstructed a section of Highland Ave. from Boston St. toward the Lynn city line.

The Town of Arlington is reconstructing a section of Massachusetts Ave. near the Cambridge line with concrete pavement.

Michael Driscoll, Superintendent of Streets of the Town of Brookline, is enjoying his annual vacation at Sharon Springs, N. Y., and will return about Sept. 5.

A section of state highway between Watertown and the Waltham city line has just been completed. The work was of bituminous macadam. The contractor is Thomas J. McGue of Watertown.

The City of Cambridge, under the supervision of E. J. Dunphy, Superintendent of Streets, is reconstructing several streets with bituminous macadam. Lincoln, Clark, Wendell, Davenport, and Orchard were completed recently.

The City of Malden is reconstructing several streets in the Edgeworth section of the city. Charles St. between Metropolitan District Parkway and Pearl St. is the largest job to be done. New curbing is being laid on Medford, Charles and Malden Sts.

The Norfolk County Commissioners have apportioned the county tax of 1921, amounting to $529,813.38, an increase of $139,813.38 over 1920, among the 27 towns and the city of Quincy as follows:

Brookline	$154,893.89
Avon	2,341.82
Bellingham	2,688.53
Braintree	17,171.89
Canton	11,447.92
Cohasset	10,329.48
Dedham	24,283.48
Dover	4,769.97
Foxborough	5,463.78
Franklin	10,493.93
Holbrook	3,902.70
Medfield	3,815.97
Medway	3,555.79
Millis	3,469.07
Milton	32,782.89
Needham	17,865.70
Norfolk	2,354.89
Norwood	33,216.33
Plainville	1,994.71
Quincy	88,287.78
Randolph	5,723.96
Sharon	5,897.41
Stoughton	10,754.11
Walpole	14,830.26
Wellesley	25,757.83
Westwood	4,336.33
Weymouth	24,196.75
Wrentham	3,295.81

New York State Road Builders' Association

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Crusher Run

Commissioner Sisson inspected the Storm King Road at Cornwall to determine whether it was feasible to widen it about 20 ft. The road is regarded by motorists as too narrow. The mountain was cut out to make this road, one of the most picturesque along the west side of the Hudson River.

In response to requests from the heads of various county fair associations, Commissioner Sisson has issued orders to the nine division engineers not to disturb signs put up by county fairs. He considers the county fair an educational institution, one which should be encouraged and given the greatest publicity possible.

The Greenfield Construction Co., Hornell, N. Y. was awarded the contract for the Hume Pike, Wyoming County, at the letting of August 12, for $145,697.00. The engineer's estimate was $173,617.00. There were 14 bidders on this contract. This same firm was awarded a repair contract job in Yates County for $39,572.25.

There were seven improvement contracts and eight repair contracts in this letting, totaling $1,081,067.81. There were 13 bidders on the Middleport-Medina Pt. 2, Orleans County contract, and 11 bidders on the 1.53 mi. repair contract in Livingston County.

The Greenfield Construction Co., and the firm of John P. Dugan & Co., Amsterdam, N. Y., are members of the New York State Road Builders' Association.

John P. Dugan & Co. Inc., Amsterdam, N. Y., was awarded the contract for a repair job in Montgomery County for $34,652.90.

There are four improvement contracts advertised in the letting to take place on August 26, 12.97 mi. three concrete and one bituminous macadam. Twelve repair contracts, 36.50 mi. in Albany, Hamilton, Jefferson, Monroe, Oneida, Ontario, Rensselaer, Stuben, Suffolk, Ulster and Wyoming Counties, are also in this letting.

With the exception of four short stretches, there is now a continuous state road from Chatham to Hudson. The small portions not completed are in and near Ghent. When the finishing touches are applied to this road it will be the first state highway extending without interruption from Chatham, N. Y., to a larger center.

All New York state highway routes are marked with bands of color on the telephone and telegraph poles. The east and west routes are marked with red, the north and south routes with blue, and diagonal routes with yellow.

H. C. Hotchkiss, Second Deputy Commissioner of the New York State Highway Department, received a letter from the Deputy Highway Commissioner of Ohio, saying that Ohio intends to adopt this system of marking highway routes. This plan is already followed in the States of Massachusetts and Connecticut. Fred W. Sarr, who was Deputy Commissioner in 1918, introduced this system.

◆

The Ohio Legislature has passed a bill appropriating $385,000 to reimburse contractors for increased freight rates on contracts in force when the increased rates went into effect.

The County Commissioner of Wayne County, Nebraska, has built 28 mi. of Road with a "heavy gang outfit" purchased from the state, according to the "Monthly Report" of the Nebraska Department of Public Works. The work done comprises 12 mi. between Wakefield and Wayne, 3 mi. for Cuming County, and 13 mi. on the Wayne County road system. All culverts and bridges put in have been built in accordance with the state's standards. The cost of the work is met from the maintenance funds. The outfit is complete, including bunk-house, cook-house, teams, etc. Commissioner Corbit expects to make the season's accomplishment 100 mi.

MEETINGS

Calendar of Coming Meetings

Aug. 23-25.—League of Cities of the Third Class in Pennsylvania.—Annual convention, Butler, Pa. Secretary, Fred H. Gates, City Clerk, Wilkesbarre, Pa.

Aug. 24-25.—Custer Battlefield Hiway Association.—Annual convention, Mitchell, S. D. W. D. Fisher, Secretary, Sheridan, Wyo.

Aug. 30-Sept. 1—Michigan State Good Roads Association.—Annual meeting, Flint, Mich. P. T. Colgrove, Pres., Hastings, Mich.

Sept. 7-9.—League of Virginia Municipalities.—Annual convention, Norfolk, Va. Secretary, L. C. Brinson, Portsmouth, Va.

Oct. 12-14.—League of Kansas Municipalities.—Annual convention, Lawrence, Kan. Secretary, John G. Stutz, University of Kansas, Lawrence, Kan.

Oct. 19-20.—North Carolina Good Roads Association.—Annual convention, Greensboro, N. C. Secretary, H. M. Berry, Chapel Hill, N. C.

Oct. 20-21.—Ohio State Conference on City Planning.—Annual conference, Columbus, O. Secretary, Charlotte Rumbold, Cleveland, O.

Oct. 24-28—American Society for Municipal Improvements—Annual Convention, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

International Association of Street Sanitation Officials

Following the same line of psychology, perhaps, that caused the street cleaners of New York City to don garbs of snowy white, the International Association of Street Cleaning Officials met in Chicago, Ill., on Aug. 10 and 11 and dubbed themselves the International Association of Street Sanitation Officials. Two other changes were made in the constitution of the organization, viz., three vice presidents will be elected instead of one, and associate membership is extended to engineers and publishers.

Among the speakers were Abram Swan, Engineer of Streets, Trenton, N. J., who spoke upon garbage collection and disposal in that city; W. F. Tallman, of Winnipeg, Canada; P. H. Connolly, City Engineer of Racine, Wis., and representatives from other cities.

W. J. Galligan was elected president; Abram Swan, E. F. Murphy and J. S. Miller, vice presidents; A. M. Anderson, secretary, and R. W. Waddell, treasurer.

PERSONAL MENTION

Crosby-Fletcher

Col. Walter Wilson Crosby and Florence Lapham Fletcher, daughter of Mr. and Mrs. Harry Perry Lapham, were married at Denver, Colo., on Aug. 3, 1921.

Col. Crosby was graduated from Maine State College in 1893 with the degree of B.C.E, receiving the degree of C. E. in 1896. In 1912 he received the degree of Doctor of Science from the Maryland State College.

From 1893 to 1897 he was engaged in railroad engineering and from 1897 to 1901 was resident engineer with the Massachusetts Highway Commission, when he resigned to become roads engineer of Baltimore County, Maryland. Subsequently he was general superintendent with the Board of Park Commissioners of Baltimore and chief engineer of the Maryland Geologic and Economic Survey. From 1908 to 1912 Col. Crosby was chief engineer of the Maryland State Roads Commission, resigning in 1912 to enter private practice.

Col. Crosby was captain and regimental adjutant in the Maryland National Guard from 1904 to 1909; major and adjutant general from 1909 to 1913 and major and inspector-general from 1913 to 1916. He served as assistant to the Chief of Staff, 15th Division, in the Mexican expedition, and at the entrance of the United States into war with Germany, was promoted to lieutenant-colonel and assigned to the 104th Engineers. In June, 1918, he went overseas. After the cessation of hostilities he served at the peace conference as a member of the Advisory Board on War Damages.

Col. Crosby is now assistant engineer with the National Park Service.

S. W. Hughes has resigned as city engineer of Port Arthur, Tex.

R. W. Rigsby has been appointed city engineer of Durham, N. C.

E. B. Bergandahl, Second Assistant Engineer of the Delaware River Joint Bridge Commission, has resigned.

H. G. Shirley, Roads Engineer of Baltimore County, Maryland, has been elected a director of the Towson National Bank.

Julius K. Monroe, former member of the West Virginia State Road Commission, has been appointed project engineer.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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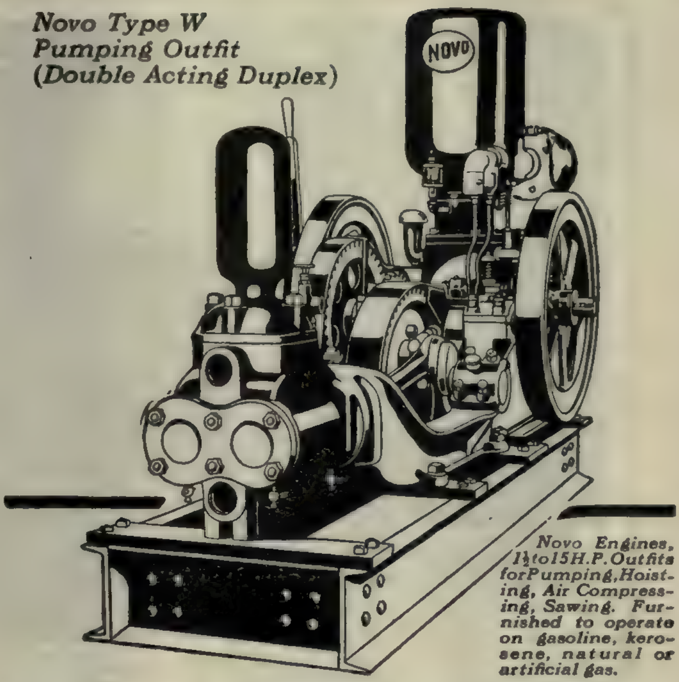

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A substantial Slag Road built with Tarvia —

The photographs show two sections of the Hopwood to Brownfield Road, South Union Township, Fayette County, Pa.

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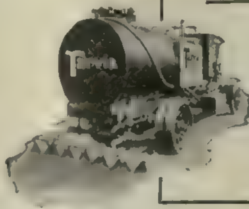

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by anyone interested. If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will be given prompt attention.

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GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE
WITH WHICH IS INCORPORATED
THE HIGHWAY CONTRACTOR AND ROAD BUILDER

Vol. LXI. NEW YORK, N. Y., AUGUST 31, 1921 Number 9

The Story of One Gravel Road*

By B. E. GRAY†

In the Washington office of the Bureau of Public Roads the history of West Virginia Federal Aid Project No. 3 is recorded somewhat after this fashion:

State	West Virginia.
County	Pendleton.
Project No.	3
Type	Gravel.
Length	4.2 miles.
Estimated total cost	$29,944.20
Federal aid	$14,972.10

To one who happens upon it in its place in the files among the 4,500 other projects, it is simply another gravel road, of which there seem to be so many—or too many, if one is inclined to be critical.

Down here they don't know it as Project No. 3 at all, but as the Franklin-Petersburg Pike. Not many can tell you how much it cost or how much of the cost was paid by Uncle Sam. What they can tell you, and will—if you give them half a chance—is that here was a road, their principal connection with the railroad 30 mi. away, which, because of its terrible condition, was largely responsible for the backwardness of their community. This road, thanks to the help of the State Highway Department and the Government at Washington, has been lifted up out of the river bed where it had lain for a century and has been broadened and smoothed and protected from the spring torrents so that it can be used with certainty the year around. If it is a mistake to build gravel roads, they will say: "Let us have more and more mistakes."

The Washington records show that the project is located in Pendleton County, which lies between

RETAINING WALL ON THE "HOG TROUGH" SECTION OF THE FRANKLIN-PETERSBURG PIKE—THE WALL, LOCATED AT A PLACE FORMERLY INUNDATED BY HIGH WATER, HAS GONE THROUGH TWO SEASONS UNDAMAGED the Shenandoah and the Allegheny Mountains in the eastern section of the state. If you refer to the atlas you will find that the county has an area of 700 sq. mi. and a population of 9,652, and that the Town of Franklin, its county seat, has only 320 people.

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*From "Public Roads," the official publication of the Bureau of Public Roads, U. S. Department of Agriculture, for July, 1921.

†Senior Highway Engineer, Bureau of Public Roads.

Value of a Road Not Always to Be Judged by Statistics

These are the cold statistics, but to really appreciate the importance of the road to the community and the state you must know something more than the statistics show. You must know, for example, that this section of the state is potentially one of its richest agricultural sections and that its backwardness is due principally to its lack of transportation facilities. Its nearest railroad point is Petersburg, 30 mi. north of Franklin, by way of the federal aid road, and the second nearest point is Harrisonburg, Va., 40 mi. easterly. Thirty miles by way of the Franklin-Petersburg Pike in its former condition was a pretty effectual barrier to free communication. Yet in spite of that, the two banks of Franklin have deposits of nearly a million dollars. Beyond Petersburg, the road leads to Cumberland, Md., where it connects with the Maryland road system, and to the southward it connects with Hot Springs, Va., the famous resort. The whole region is one of the most picturesque sections of West Virginia, and when finally opened for through automobile traffic will undoubtedly attract tourists from far and near.

The Old Road Often Flooded

The old road followed the South Branch of the Potomac River. The alignment was poor and the grades heavy, and it was in extremely bad condition. In places it followed the bed of the river itself until, coming to a sharp bluff, it would turn in toward the bank and after making a climb of 10 to 12% for several hundred feet would pitch down again on the other side into the river bed. In times of high water it was flooded from 2 to 10 ft. deep and all communication between the county and the outside world would cease. Even in summer, the road was often closed to traffic for days at a time as a result of heavy rains which convert the tributaries of the South Branch into mountain torrents.

In 1917, in order to conform to the requirements of the Federal Aid Law, the Legislature passed a road bill which provided for a two-headed commission to have supervision of federal and state aid work. On account of the limited state funds provided, it was necessary to supplement them by county levies, and Pendleton County was one of the first to supply funds for the purpose.

A meeting was held with the county court in the fall of 1917 and they were induced to pass a court order appropriating $12,500 to be matched by a similar amount of federal aid. At the time the county had no highway engineer, nor anyone versed in the building of highways, so an engineer was loaned by the Bureau of Public Roads to make a preliminary survey of the proposed project. He found the people rather skeptical as to the outcome of the whole procedure. They had seen so much money wasted under the old county supervisor system that they could not help but feel that this method offered only a quicker means of getting rid of the money.

High Type Surface Versus Extension of Mileage

Some of the county court desired a short piece of road with a high type surface, but looking at the situation from the viewpoint of the general welfare of the people it was evident that the first thing to be done was to build bridges over the streams tributary to the South Branch, which would at least permit uninterrupted summer travel, and next to build an earth road on a location and grade that would be above high water, and would permit travel the entire year around.

The first need was met by a state project for which automobile funds were matched against local county funds, and several bridges were built over the most frequently flooded streams. A survey was then made of 6 mi. (and later 4 mi. additional) of the road from Franklin extending northerly. Two locations were possible—either to follow along the mountain-side above the river, and cut out an entirely new road, or to follow generally the old roadbed with certain modifications in alignment and grade, building embankments to a height that would put them above flood-water levels and protecting the banks from erosion by retaining walls or riprap. At first glance it seemed that the hillside route would be preferable, and a survey was made on this location, following a natural shelf. This survey showed, however, that there would be considerable difficulty in building the higher line, on account of the large percentage of ledge encountered, and when the estimate was made up it proved to be cheaper to follow the old location.

The work was advertised for bids in March, 1918, and one contractor was brave enough to travel the 30 mi. from the railroad to appear at the letting. The cost of putting in an outfit was so great that, instead of bidding a unit price, he made a cost-plus proposition to the county. This was very fair and was accepted. He agreed to put his equipment on the work, consisting of steam shovel, teams, drills, etc., and to receive as compensation cost plus 10%, and plant rental at 1.75% per month, not to exceed eight months. The federal agreement estimate price was 90 ct. per cubic yard, and as labor was $2.50 a day and teams $5, it was felt that the work could be done at these figures. All materials and supplies had to be hauled the 30 mi. from the railroad station. The steam shovel was carried in by sections, as it was impossible to carry the whole shovel over a steel bridge crossing the river at a point midway between Petersburg and Franklin.

Local Labor Employed on the Work

Construction was begun in the early summer of 1918 and has continued to the present time, using local labor drawn from among the farmers themselves, nearly all of whom are well to do. For most of them it was their first experience in working under a contractor's foreman, and they found the discipline somewhat harsh. They complained so effectually that, finally, to keep the peace the energetic foreman was transferred to another job and a local foreman was put in his place. It was not long, however, before the new man, by his very leniency, had caused more trouble than the former, who though strict had been absolutely impartial; and the men themselves requested the return of their first foreman. He is still in charge, and the excellent construction is in a large measure due to his untiring, conscientious efforts. He has built up an "esprit de corps" which is remarkable. The men have been fired by his enthusiasm. They look upon the road as their road and they seem intent upon putting forth their best efforts to obtain high-class workmanship.

WHAT AN ORDINARY GRAVEL ROAD MAY MEAN to a community under certain conditions is told in the accompanying article by one of the engineers of the U. S. Bureau of Public Roads describing the construction of West Virginia Federal Aid Project No. 3.

PENDLETON COUNTY, WEST VIRGINIA, one of the richest agricultural sections of the state, was practically isolated from the rest of the world because its chief outlet to the railroad was over an all but impassable road.

FEDERAL AID enabled the county to reconstruct the road, thus removing the barrier to progress and prosperity that for years had held back the development of the county. If—as is sometimes claimed—the use of federal funds to build gravel roads is a mistake, the verdict of the Pendleton County farmers, says the author, will be: "Let us have more and more mistakes."

The original federal aid contract, 4 mi. in length, was completed in 1920. On the 4 mi. the Government paid $14,972.10, approximately half the total cost. The cost of the grading was a little under $1 per cubic yard. The people of the county felt that this was expensive and demanded that another letting be held for the next section of the work. Only one bid was received, and that, which offered to do the work at $1.75 per cubic yard, was rejected. The original contractor is still carrying on the work at cost plus 10%, with a low rental charge for equipment.

Nearly 8 mi. have now been completed and about 80,000 cu. yd. of material moved. The riprap and rubble walls, which protect the embankment from the stream, have been constructed from excavation material, the percentage of rock running in places as high as 80%. In addition the road has been surfaced with gravel 8 in. thick at the sides and 12 in. thick at the center, and under the maintenance of a regular patrolman is kept in excellent condition. The county also has an engineer who directs the work on this and another federal project on the Petersburg end.

Costs for the whole work, averaged over three construction seasons, are $1.10 per cubic yard for unclassified excavation; riprap, $4.50 per cubic yard; class A concrete (bridges), $22 per cubic yard; and 15-in. culvert pipe, $2 per foot.

(Concluded on Page 118)

SECTION OF THE OLD ROAD IN THE RIVER BED—ONE OF THE MANY THAT WERE OFTEN FLOODED

AN IMPROVED SECTION—FRANKLIN-PETERSBURG PIKE, PENDLETON COUNTY, WEST VIRGINIA

Contractors' Cost Data on Concrete Paving*

Costs Committee of Northwestern Association of General Contractors Prepares Detailed Estimates of Cost for a Concrete Paving Job under 1921 Conditions

The paving section of your Committee on Education as to Costs has given much thought to the preparation of a study of paving costs and has concluded to present at this time an estimate of the cost of one-course concrete paving laid under the Minnesota specifications for 1921.

Before proceeding with such an estimate it is necessary that the various conditions affecting the work be known, and you committee has prepared and used as a basis of this study the following:

GENERAL SPECIFICATIONS FOR THE IDEAL CONCRE HIGHWAY PAVING JOB

Plans

Plans for the work shall show the line, grade, and cross-sections of the road, together with the location of detours and other roads adjoining the work, also the location of railway facilities and sources of approved water supply.

> *COST DATA OFTEN MISLEAD because they are incomplete. Figures that are both complete and authoritive are obtained with comparative infrequency. For that reason, the data in this article should be particularly valuable to road builders. They are set forth in sufficient detail so that they can be utilized in many kinds of work besides that for which they were compiled and in many parts of the country other than that for which they were derived. Moreover, they are the results of study by men peculiarly qualified for the work they have accomplished.*

Subgrade

The subgrade shall consist of a graded roadway at least 30 ft. on the crown in such condition that no part of it varies more than 0.1 ft. from the true grade. It shall be in such condition that no material has to be handled for a distance of over 10 ft. in order to put the roadway in shape to lay the pavement on. The material in the roadway shall be sandy loam, sandy enough to drain quickly and with enough binding quality to make it pack under traffic; it shall be of such nature that it can be shoveled easily without picking or plowing. It is quite important that the soil and surface shall meet the foregoing specifications.

Line and Grades

The road to be constructed shall in the main be straight, except that some curves that do not require widening or any superelevation may be allowed. No grade of over 1.5 ft. per 100 ft. shall exist. No bridges, railway crossings or other structures shall exist to interfere with construction operations.

Time of Awarding Contract

Contract shall be awarded prior to January first of the year in which the work is to be done.

Scope of the Work

The work shall include 21 mi. of paving, no part of which shall be further than 3.5 mi. from a railway siding.

Railway Facilities

A suitable location for at least 1,000 ft. of railway trackage, open at both ends and suitable storage space, shall be available for the handling of all aggregate and other material entering into the construction of the pavement. Such railway facilities shall be not further than 500 ft. from the center line of the highway to be constructed, measured along an available road, which road must be in good condition and of such quality that it will stand truck travel with a reasonable amount of maintenance. Railway facilities shall not be further than 0.5 mi. from the center of each 7-mi. section of the project.

Train service shall be such that material will be handled promptly from the source of supply to the job. It shall be such that at least two switches will be provided each day.

Source of Supply of Material

The sources of supply of materials, except steel, shall be at such a distance from the unloading plant that a 5 ct. per cwt. freight rate will apply on sand and rock.

They shall be of such capacity that the contractor shall be, at all times, supplied with material for his work, and in such quantities as will require a minimum amount of stocking and rehandling.

Cement shall be delivered so that a warehouse large enough to contain 3,000 lbs. will provide sufficient storage.

Water Supply

The sources of water will be adjacent to the roadway and shall be such that an adequate supply of water can be obtained for mixing and curing (at least 40 gal. per minute).

Sources of supply shall be so located that a maximum of 3 mi. of 2-in. pipe will be required.

Detours

Proper detours will be provided and maintained by the owner so that traffic will be, at all times, diverted from the highway under construction in such shape that the detour shall be preferred by the traveling public to the road under construction.

Detailed Specifications

The detailed specifications shall be the same as the Minnesota State Highway specifications for the year 1921.

Having now before us the general specifications for the "ideal concrete paving job" and the Minnesota detail specifications for one-course concrete pavement for 1921, we must determine on what method of laying pavements our estimate shall be based. Your committee, after the investigation of methods at present in use in laying concrete pavement in Michigan, Indiana, Illinois, Iowa, Minnesota, Oregon and Washington, is forced to the conclusion that there are in general use at the present time only two methods of laying concrete pavements on highways, viz:

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*A report submitted by the Committee on Education as to Costs of the Northwestern Association of General Contractors and printed in "The Bulletin of the Associated General Contractors" for July, 1921.

Committee: J. C. Baxter, Chairman; A. A. McCree; Day Okes; N. F. Helmers; F. C. Peabody; A. F. Johnson.

(a) Hauling dry aggregate in trucks to some style of paving mixer.

(b) Hauling dry aggregate on railway track with locomotives to some type of paving mixer.

Your committee is, of course, familiar with the fact that many variations of these two methods have been, and are being used, but believes all these variations are special methods adopted by the contractors to meet some peculiar features of the particular job in hand. We have, therefore, decided to present for your consideration two estimates of laying concrete pavement, Estimate "A" using auto trucks for hauling dry aggregate, Estimate "B" using railway track and locomotives for hauling dry aggregate.

At this point your committee wishes to go on record as follows:

First: We do not believe the most efficient method of laying concrete pavement has yet been definitely established.

Second: We do not recommend any particular method of laying concrete pavement and wish to impress upon our members the necessity for a careful study of the geographical, physical and financial limitations of each job before a method of work is determined upon.

Before proceeding with our estimates certain assumptions were made, and these, we believe, upon examination will be found to closely approximate actual conditions in Minnesota and the surrounding territory.

(a) The working period in each year is assumed to consist of an average of 20 working days per month for 5 months, or 100 working days per year.

(b) The capacity of the paving mixer and its necessary hauling equipment is assumed at 400 ft. of pavement on the average per day, or 7 mi. in the assumed working season for one paving unit.

(c) The ideal job in assumed to be carried out with three paving units in one operating season.

(d) The prices used for aggregate are as follows:

Rock per ton f. o. b. shipping point	$1.75
Freight per ton at 5 ct. per cwt	1.00
Rock f. o. b. job per ton	$2.75
Tons per cubic yard 1.30	
Rock per cubic yard 1.30x$2.75=$3.575	
Sand per ton f. o. b. shipping point	$0.50
Freight per ton at 5 ct. per cwt.	1.00
Sand f. o. b. job, per ton	$1.50
Tons per cubic yard 1.50	
Sand per cubic yard 1.50x$1.50=$2.25	
Cement per barrel, not including sacks, f. o. b. job	$2.50
Steel per lb. f. o. b. job.	.035

(e) The prices used for labor are shown in detail in Estimate "A" and "B," but were derived from the following basic rates:

Common labor, per hour	$0.50
Cement handling, per hour	.65
Machine operators, per hour	.75
Teams, per hour	.90

(f) For hauling by trucks the use of 2½-ton capacity trucks, equipped with pneumatic tires and carrying 2 dry batches of 4 bags of cement, were assumed as being the most common present practice.

(g) For hauling by railway track and locomotives the use of flat cars, carrying 2 steel batch boxes of 4-bag capacity and hauled by 6-ton gasoline locomotives on 25-lb. rail, equipped with steel ties, was assumed as being the most common present practice.

(h) For unloading rock and sand from railway cars and charging bunker the use of a 20-ton locomotive crane, equipped with 60-ft. boom and 1-cu. yd. clamshell was assumed as the most common present practice.

Your committee recognizes the various forms of unloading equipment in use, but is of the opinion that any satisfactory variation from a 20-ton locomotive crane will be found to entail about the same initial investment.

We will now proceed to discuss the various items that enter into the cost of laying one-course concrete pavement, and as all general items are common to both Estimate "A," covering the method of using auto trucks, and Estimate "B," covering the method of using railway track and locomotives, we will take up each item in what appears to us to be the logical order of its importance. Each item discussed is shown in detail in Estimates "A" and "B" attached to this report.

Depreciation

Depreciation for both Estimates "A" and "B" has been calculated on the basis of the Official Rental Schedule submitted to the Associated General Contractors by their committee on methods at New Orleans, Jan. 26, 1921.

The list of plant and tools required for methods "A" and "B" on which depreciation has been calculated were each prepared jointly by two contracting firms with experience in the method assigned to them.

Interest

Interest on plant and equipment has been calculated using a basic rate of 6½% per annum.

Capital for carrying on the business will be necessary and, in our opinion, $75,000 for each paving unit will be required. Interest on this amount has been calculated at 6½% per annum for 6 months.

Supervision

The actual general office overhead of various contracting firms has been given us for our information and we find this item to vary from 2% of the total cost on jobs involving a large percentage of material purchased to 3% on jobs involving a large percentage of labor. As the cost of aggregate in concrete pavement is somewhere in the neighborhood of 50% of the total cost, we have used 2% as the cost of general overhead.

In addition to the general office expenses, we must consider the salary value of the contractor himself, and our opinion is that a man capable of administering a job involving the construction of 21 mi. of concrete pavement in one season is worth $5,000 per year, whether engaged in business as a contractor or as an employee. We assume this man to have general charge of the three-unit paving outfit with a general foreman under him in charge of each unit.

Taxes

This item is calculated at 0.59% per annum on the new value of the plant (not including auto trucks). The license fee on auto trucks is assumed at $100 per annum per truck.

Storage

This item is calculated at 3½% per annum on the value of the plant in accordance with the rate shown in the Official Rental Schedule of the Associated General Contractors.

Bond

For the sake of uniformity this item is calculated at 1½% on $300,000.00 or $4,500.00 for each paving unit.

Insurance

Fire insurance is calculated at 1% per annum on the value of the plant (not including trucks) in accordance with the rate shown in the Official Rental Schedule of the Associated General Contractors.

Workingmen's compensation and public liability insurance is calculated at 3% on the total pay-roll.

Insurance on trucks has been allowed, including personal injuries, theft, fire and property damage.

Freight on Outfit

This item varies for Estimates "A" and "B" and is shown separately in each estimate.

Loss on Railway Fare

Every contract carried out in a location outside of the larger centers of population involves some expense on account of railway fares paid for employees, and we have allowed $500 for the season to cover this item for each paving unit.

Camp Site and Material Yard

Each paving unit will require sites for boarding camps, material storage and loading plant, together with 1,000 ft. of railway track.

We estimate the ground rent for various facilities at $250 and assuming the contractor pays all the labor, cost of installing and removing railway track, plus interest and depreciation on the cost of the track material, we estimate 1,000 ft. of track with two switches at $1,500.

In addition to the losses covered by various forms of insurance and to the cost of camp sites and storage grounds there are always some miscellaneous damage claims in connection with carrying on a piece of work that require settlement, and we have allowed $500 for each paving unit to cover this item.

Repairs

All items of repairs, both shop and field, except auto tires, have been calculated at the rates shown in the Official Rental Schedule of the Associated General Contractors, making such allowances as seem proper in order to fit them to the job under consideration.

Pneumatic tires have been calculated on the basis of 5,000 mi. of useful life.

Labor

This large item varies for Estimates "A" and "B" and separate labor schedules are included in each estimate. The entire cost of moving on to the work, executing the work and moving off has been included.

Fuel and Oil

This item also varies for Estimates "A" and "B" and details are included for each estimate.

Aggregate

This item, being common to Estimates "A" and "B," has been calculated for one paving unit as follows:

7 mi. of paving at 10,560 sq. yd. per mile equals 73,920 sq. yd. per unit.
Cubic yards of rock required per square yard for paving equals 0.178.
Cubic yards of sand required per square yard for paving equals 0.089.
Barrels of cement required per square yard of pavement equals 0.3.
Pounds of steel required per square yard of pavement equals 2.76.

Rock, 73,920x0.178=13,157.76 cu. yd. at $3.575	$47,038.99
Sand, 73,920x0.089=6,578.88 cu. yd. at $2.25	14,802.48
Cement, 73,920x0.3=22,176.00 bbl. at $2.50	55,440.00
Steel, 73,920x2.76=204,019.2 at $0.035	7,140.67
Total	$124,442.14

Material Shrinkage and Yard Losses

2% of all material	$2,488.44
Losses on cement sacks 2% on 88,000 sacks equal 1760 sacks at 25 cts.	440.00
Total cost of aggregate	$127,305.58

Contingencies

Your committee believes that no estimate of the cost of work, no matter how carefully made, can take into consideration all of the small and uncertain items that help to swell the final total cost, and we have, therefore, added 5% to our estimate to cover unforeseen contingencies.

Fine Grading

As fine grading is a matter of such importance to paving contractors, we have not included the cost of it in Estimates "A" and "B," but instead submit a separate analysis of the cost of fine grading for the ideal job under consideration and included in this report as Estimate "C."

Profit

Your committee believes any discussion of the amount of profit to be added when estimating work would be out of place in this report, but we wish to impress upon our members that laying of concrete highway paving can only be carried out with economy when the conditions are such that very great regularity in operation can be secured and that all the forces of nature work to interfere with this required regularity. We, therefore, believe that highway paving contracts are particularly hazardous, and for this reason should carry fair margins for profit.

We will now recapitulate the various items of Estimates "A" and "B" and "C." The estimates given herewith are for one paving unit. (See table.)

In conclusion, we wish to say in regard to the use of this report by our members that:

First: The estimates for one-course concrete paving have been based on an "ideal job," and many costs will be increased by conditions as actually encountered in the field.

Second: A paving job in Minnesota, from the very nature of the climate, is one that can only occupy the contractor's outfit about five months out of the calendar year, and consequently, unless he has another line of business to occupy the winter months, his whole annual cost of operation and profit must be covered in that short period.

Third: The final figures obtained in these estimates are based on assumed costs of plant, labor and materials, and in using this report as a guide when making estimates, contractors should be careful to revise our figures in accordance with the market conditions existing at the time their estimate is made.

RECAPITULATION OF GENERAL ITEMS OF ESTIMATES "A," "B" AND "C"

	"A"	"B"	"C"
A—Depreciation	$22,624.03	$22,589.09	$1,207.25
B—Interest	7,990.89	9,737.27	561.32
C—Supervision	7,666.00	7,666.00	230.00
D—Taxes	507.87	662.59	20.00
E—Storage	2,990.40	3,930.65	50.00
F—Bond	4,500.00	4,500.00	135.00
G—Insurance	2,982.94	1,398.60	260.00
H—Freight on Outfit	3,300.00	5,000.00	250.00
J—Camp, Yard Site and Trackage	2,250.00	2,250.00	....
K—Repairs	17,647.17	14,343.69	500.00
L—Labor	41,098.00	46,620.00	7,600.00
M—Fuel and Oil	5,900.00	5,625.00	240.00
N—Aggregate	127,350.58	127,350.58	....
O—Contingencies 5 per cent.	15,000.00	15,000.00	450.00
Total net cost per season for one paving unit	$261,807.88	$266,673.47	$11,503.57
Square yds. of paving laid by one unit	73,920.00	73,920.00	....
Cost per square yard	3.54	3.61	.155

Estimate "A," Cost of Laying One-Course Concrete Pavement

Equipment Investment	$85,436.70		
A—Depreciation			$22,624.03
B—Interest			
Equipment Inv. @ 6½% on	85,436.70	$5,553.39	
Capital @ 3¼% on	75,000.00	2,437.50	7,990.89
C—General Supervision			
General Office, 2% estimate	300,000.00	6,000.00	
One-third Contractor's Salary		1,666.00	7,666.00
D—Taxes			507.87
E—Storage			
Equipment Inv. @ 3½%	85,436.70		2,990.40
F—Bond—1½% on	300,000.00		4,500.00
G—Insurance			
Workman's Compensation and Public Liability, 3% on P/R		1,232.94	
Truck Coverage 7 @ 150.00		1,050.00	
Truck License		700.00	2,982.94
H—Freight Equip. and Misc. Only		2,800.00	
Railway Fares (Labor)		500.00	3,300.00
I—Camp Site and Yard			
Site Rental		250.00	
Property Damage		500.00	
Trackage		1,500.00	2,250.00
Equipment except trucks		6,362.17	
K—Repairs Trucks (Chassis and Bodies)		4,935.00	
Tires		6,350.00	17,647.17
L—Labor			41,098.00
M—Fuel and Oil, General		3,125.00	
Trucking		2,775.00	5,900.00
N—Material			127,350.58
O—Contingencies 5% Est. $300,000.00			15,000.00
			$261,807.88

Unit cost per square yard pavement only $\frac{\$261,807.88}{73920} = \$3.54$

Exclusive of shoulders and finish grade.

DEPRECIATION

Equipment	Investment	% Dep.	Amt. Dep.
Locomotive Crane	15,050.00	9½	$1,429.75
Crane Track, etc	5,000.00	50	2,500.00
Bins	1,600.00	80	1,280.00
Mixer	8,800.00	15	1,320.00
Pump	1,700.00	12½	212.50
Pipe and Fittings	3,732.85	25	933.21
Tamper	1,940.00	50	970.00
Road Forms	1,785.00	37½	669.37
Blacksmith Shop	1,021.19	50	510.59
Ford Truck and Car	1,418.65	50	709.33
Camp Equipment	6,725.90	35	2,354.07
Trucks	32,900.00	25	8,225.00
Truck Parts	1,750.00	0	
Small Tools and Misc. Equip.	2,013.11	75	1,510.21
	$85,436.70		$22,624.03

SHOP AND FIELD REPAIRS

Equipment	Investment	% Repair	Amount Repair
Locomotive crane	15,050.00	14	$2,107.00
Track	5,000.00	0	
Bins	1,600.00		
Mixer	8,800.00	15	1,320.00
Pump	1,700.00	10	170.00
Pipe and fittings	3,732.85	10	373.29
Tamper	1,940.00	18	349.20
Road forms	1,785.00	18	321.30
Blacksmith shop	1,021.19	0	
Ford truck and car	1,418.65	36	510.72
Camp equipment	6,725.90	18	1,210.66
Trucks	32,900.00	15	4,935.00
Truck parts	1,750.00	0	
Truck tires (extra)			6,350.00
			$17,647.17

UNLOADING PLANT

1 20-ton locomotive crane, 60-ft. boom with 1-yd. bucket, complete	15,050.00	
Crane track 1,000-ft. in place and 1,000-ft. switch track	5,000.00	
Rock and sand bins (30 yd. each) incl. retaining walls	1,600.00	
150 ft. ½-in. rope	87.75	
2 car movers	10.50	
2 10-in. cable blocks	14.30	
2 10-in. wood snatch blocks	9.40	
3 Carbic lights	165.00	
500 ft. 1-in. black pipe	48.05	
3 engine oilers	3.75	
1 set engine and boiler tools	60.00	
3 lanterns and globes (red and white)	3.63	
3 cement bag trucks	12.75	
1 cement bag baler	35.00	
4 wheelbarrows	31.40	22,131.53

MIXING PLANT

1 4-bag mixer, tools, repair parts and fittings	8,800.00	
125 ft. 1¼-in. special hose	62.50	
Funnels, hose clamps, etc.	12.00	
Lubricating cans and drums	8.00	8,882.50

PUMPING EQUIPMENT

2 4x6-in. single acting Triplex pumps	1,700.00	
3 mi. 2-in. black pipe, 15,840 ft.	3,311.14	
200 2-in. black tees	65.00	
4 doz. 90-deg. bends	10.56	
150 2-in. R. R. unions	240.00	
250 2-in. black plugs	20.00	
50 2-in. assorted nipples	4.50	
10 2-in. gate valves	70.00	
3 1-in. globe valves	4.05	
4 adjustable relief valves, ¾-in.	6.60	
1 36-in. pipe wrench	5.47	
6 24-in. pipe wrenches	18.12	
2 50-gal. gas drums	6.00	
2 15-gal. lubricating drums	2.50	
Oil cans, funnels, strainers, etc.	5.50	5,469.44

FINISHING EQUIPMENT

1 18-ft. 1-in. Crown tamper, tools, repair parts, etc.	1,940.00	
2,000 road forms with stakes and wedges	1,785.60	
1 form stake puller	5.00	
9 canvas coverings	555.75	
5 canvas frames	100.00	
1 tool box on wheels	45.00	
1 canvas belt for hand finish	40.14	
1 5-in. hand roller	26.00	
150 ft. ¾-in. hose for sprinkling	36.00	4,533.49

GENERAL EQUIPMENT

1 Ford truck, haul pipe, forms, etc.	837.10	
1 Ford touring car	581.55	
1 doz. lanterns, white and red globes	14.00	
Built-up barricades	125.00	
Detour signs	150.00	
1 first aid outfit	50.00	
Small tools	265.00	2,022.65

CAMP EQUIPMENT SHEDS, ETC.

Cement shed, (3,000-bbl. storage)	1,500.00	
Office building and equipment, also tool house	600.00	
Machine and blacksmith shop	200.00	
Kitchen and dining room combined	800.00	
8 16x16-ft. army tents, frames and floors, wall, 6-ft. wall 12-oz. dbl. fill	678.40	
500 ft. ¾-in. pipe and fittings	32.50	
75 men equipment @ $40.00 less 15%	2,550.00	
Boiler house, 1,200 ft., B. M., @ 50.00 S. H. and hdw. and millwork and roofing	85.00	
Coal crib (no floor)	30.00	
Water supply, well, pipe, pump, etc.	250.00	6,725.90

BLACKSMITH, REPAIR AND MACHINE SHOP

1 Babbitt ladle, 8-in.	4.00
1 5-lb. soldering iron	1.55
1 1-qt. blow pot	6.40
1 14-in. jack plane	5.60
2 squares	3.30
6 nail hammers	7.88
2 26-in. 8-pt. hand saws	5.42
1 5-in. bench axe	1.89
1 set wood bits	7.20
12 padlocks	15.85
1 forge, without tank	44.50
12 safety hasps	3.35
3 screw drivers	2.22
6 assorted cold chisels	2.55
3 center punches	1.05
18 assorted 3-6", 3-8" and 6-14" files	8.69
5 lb. welding compound	0.50
1 4-lb. blacksmith hammer	0.72
1 engineer's hammer, 3-lb.	1.70
1 carpenter's level, 28-in.	1.85
1 rip hand saw	2.72
6 hatchet handles	1.17
6 hammer handles	0.92
1 hack saw frame	1.12
3 doz. blades	2.70
1 draw knife	1.43
1 spoke shave	0.51
1 4-hp. gas engine or motor for driving post drill, emery, etc.	150.00
2 rivet busters	0.75
3 cold cuts	2.25
1 ea. ½ and ⅝-in. rivet snap	2.50
1 ea. ½ and ⅝-in. straight dolly	1.50
1 ea. ½ and ⅝-in. goose neck dolly	2.50
1 ea. ½ and ⅝-in. steel dolly	3.00
2 backing out punches	1.50
18 ½-in. drift pins	2.00
18 ⅝-in. drift pins	2.50
1 set 1-ton chain blocks	40.00
1 35-ton ball bearing jack	130.00
2 7-ton steamboat ratchets	16.00
Set stock and dies pipe, ⅛ to 2½ in. Bolt, ¼ to 1-in.	63.00
Twist drill, ⅛ to 1-in.	30.54
30 wire rope clips, assorted	10.00
2 long handled axes	4.00
30 shovel handles, assorted	12.00
8 grub hoe handles	4.16
1 5-gal. gas can	1.50
3 wood jacket oil cans (2 gal. capacity)	4.50
6 ax handles	2.97
1 carborundum grinder	5.95
12 sledge hammer handles	4.10
2 10-lb. sledges	2.60
2 16-lb. sledges	4.16
1 post drill, hand, with power attachment	27.80
1 150-lb. anvil	16.50
4 20-lb. pinch bars	6.00
2 ⅝-in. 14 ft. log chains	13.20
1 ¼-in. 12-ft. log chain	1.47
100 ft. ¾-in. Manila rope	3.22
4 kegs, 6, 8, 10, and 30 wire nails	18.40
1 roll No. 10 wire	4.50
1 blacksmith's vise	15.70
1 pipe vise	5.00
2 2 and 12 jack screws	10.50
1 set double and triple blocks for ¾-in. rope	5.00
150 lb. waste	18.00
1 36-in. Trimo wrench	5.77

2 24-in. Trimo wrenches	6.20	
2 Trimo wrenches, 10-in.	2.14	
2 8-in. Trimo wrenches	1.92	
2 sets open end wrenches, ¼ to 1-in.	5.00	
1 anvil handle	0.80	
6 S. & Q. house brooms	4.50	
2 water barrels	4.00	
½ doz. G. I. pails	4.80	
1 acetylene welding outfit, complete	200.00	1,021.19

HAULING EQUIPMENT

7 trucks, 2½-ton complete, with cabs dump bodies, hoists, pneumatic tire	32,900.00	
Repair parts and tools	1,750.00	34,650.00
TOTAL EQUIPMENT INVENTORY		$85,436.70

L—LABOR

General superintendent (Less time at fine grading)	3,200.00	
Time keeper, 7 mos.	1,050.00	
Material clerk, 5 mos.	625.00	4,875.00
Loading equipment at yard		
1 foreman, 6 days @ 7.00	42.00	
6 men, 6 days @ 5.00	180.00	222.00
Unloading all equipment at job		222.00
Re-shipment to yard		444.00
Unloading coal and steel		
9 men, 10 days @ $5.00	450.00	450.00
Unload, haul, place and dismantle pipeline		
3 men, 120 days @ 6.00		2,160.00
General yard work and plant erection		
4 men, 12 days @ $5.00	240.00	240.00
General plant labor		
1 blacksmith, 5 mos. @ $200	1,000.00	
1 helper, 5 mos. @ $150	750.00	
1 yard foreman, 7 mos. @ $140	980.00	2,730.00
Camp labor		
Erection:		
1 man, 10 days @ $7.00	70.00	
8 men, 10 days @ $5.00	400.00	
Operation:		
1 cook, 7 mos. @ $125.00	875.00	
1 bull cook, 5 mos. @ $60.00	300.00	
2 flunkies, 6 mos. @ $60.00	720.00	2,365.00
General labor:		
1 crane operator, 140 days @ $10	1,400.00	
1 fireman, 140 days @ $6.00	840.00	
2 spotters, 120 days @ $5.50	1,320.00	
1 bin gate, 110 days @ $5.00	550.00	
5 cement men, 110 days @ $6.50	3,575.00	
1 pump man, 140 days @ $6.00	840.00	
1 tamper operator, 110 days @ $7.00	770.00	
1 mixer operator, 110 days @ $7.50	825.00	
1 mixer fireman, 110 days @ $6.00	660.00	
3 concrete levelers, 100 days @ $6.00	1,800.00	
1 steel man, 30 days @ $5.00	150.00	
1 truck dumper, 100 days @ $5.00	500.00	
1 finisher, 100 days @ $7.50	750.00	
2 form setters, 110 days @ $7.00	1,540.00	
1 form setter helper, 100 days@$5.00	500.00	
1 paving foreman, 140 days @ $8.00	1,120.00	
1 truck driver, 120 days @ $5.00	600.00	17,740.00
Covering and curing concrete:		
3 men, 110 days @ $5.00	1,650.00	
1 watchman, 6 mos. @ $100	600.00	2,250.00
Road maintenance:		
1 man, 50 days @ $5.00	250.00	
1 team, 50 days @ $9.00	450.00	700.00

TRUCKING

1 foreman of transportation, 5½ mos. @ $250	1,375.00	
5 truckmen, 5½ mos. @ $150	4,125.00	
2 truckmen, 4 mos. @ $150	1,200.00	6,700.00
TOTAL LABOR		$41,098.00

M—FUEL AND OIL

General:			
Crane coal, 140 tons @ $7.50		1,050.00	
Oil		95.00	
Camp coal, 20 tons @ $7.50		150.00	
Mixer coal, 50 tons @ $7.50		375.00	
Oil		45.00	
Gas, engines and Fords		1,050.00	
Oil, gas engines and Fords		300.00	
Kerosene lights		60.00	$3,125.00
Trucking			
Gas, 8,000 gal. 6 mi. per gal. @ 26c gal.		$2,080.00	
Oil, 75 mi. per gal. @ 90c		630.00	
Grease	65.00	2,775.00	$5,900.00

N—MATERIALS

7 mi. @ 10,560 sq. yd., 73,920 sq. yd.			
Amount required:			
Rock, 73,920x0.178—13,157.76 cu. yd. @ $3.575		$47,038.99	
Sand, 73,920x0.089—6,578.88 cu. yd. @ $2.25		14,802.48	
Cement, 73,920x0.3—22,176.00 bbl. @ $2.50		55,440.00	
Steel, 73,920x2.762—204,167 lb. @ 0.035		7,145.85	$124,427.32
Cost estimate, materials:			
Rock cost, ton	$1.75		
Freight	1.00		
	$2.75x1.3—$3.575 per yd.		
Sand cost	0.50		
Freight	1.00		
	$1.50x1.5—$2.25 per yd.		
Cement cost	2.50		
Material shrinkage and yard losses, 2%			$2,488.55
Loss on cement sacks, 2%x88,000 sacks—1,760 sacks @ 25c.			440.00

O—CONTINGENCIES

5% of $300,000	$15,000.00

Estimate "B," Cost of Laying One-Course Concrete Pavement

Using Railway Track for Haulage

Equipment investment $112,304.20		
A—Depreciation		$22,589.09
B—Interest		
Equipment invest. ....112,304.20@6½%	7,299.77	
Capital ....75,000.00@3¼%	2,437.50	9,737.27
C—General supervision		
Genl. Office 2% est. 3000,000.00	6,000.00	
Supvn. ⅛ Con. Sal....	1,666.00	7,666.00
D—Taxes		662.59
E—Storage 3½% equipment inventory		3,930.65
F—Bond 1½% on 300,000.00		4,500.00
G—Insurance, Workmen's Compen & Pub. Lia. 3% P. R. 46,620.00		1,398.60
H—Freight—on equipment only railway fares "labor"	500.00	5,000.00
I—Camp site & yard		
site rental	250.00	
Property damage	500.00	
Trackage	1,500.00	2,250.00
K—Repairs		14,348.69
L—Labor		46,620.00
M—Fuel & oil		5,625.00
N—Material		127,350.58
O—Contingencies 5% est. 300,000.00		15,000.00
		$266,673.47

Unit cost per sq. yd.—pavement only (exclusive of shoulders and finish grade) $\frac{\$266,673.47}{73,920} = 3.61$

DEPRECIATION

Equipment	Investment	% Dep.	Amt. Dep.
Loco. crane and clamshell	15,050.00	9½	$1,429.75
Crane, track, etc.	5,000.00	50	2,500.00
Bins	1,600.00	80	1,280.00
Mixer	8,800.00	15	1,320.00
Pump	1,700.00	12½	212.50
Pipe and fittings	3,732.85	25	933.21
Tamper	1,940.00	50	970.00
Road forms	1,785.00	37½	669.37
Blacksmith shop	1,021.19	50	510.59
Ford truck and car	1,418.65	50	709.33
Camp equipment	6,725.90	35	2,354.07
Small tools & Miscl. Equip.	2,013.11	75	1,510.21
4 6-ton gasoline locomotives	18,800.00	18¾	3,525.00
40 roller bearing running gears	4,880.00	9½	463.60
21,120 lin. ft. port. track, 25 lb.	29,563.00	9½	2,971.27
105 lin. ft. curved track	178.50		
9 complete half turnouts	1,530.00	18¾	1,230.19
80 batch boxes	6,480.00		
1 batch box bail	81.00		
	$112,304.20		$22,589.09

SHOP AND FIELD REPAIRS

Equipment			
Locomotive crane	15,050.00	14	2,107.00
Track	5,000.00	0	
Bins	1,600.00	0	
Mixer	8,800.00	15	1,320.00
Pump	1,700.00	10	170.00
Pipe and fittings	3,732.85	10	737.20
Tamper	1,940.00	18	340.20
Road forms	1,785.00	18	321.30
Blacksmith shop	1,021.19	0	
Ford truck and car	1,418.65	36	510.71
Camp equipment	6,725.90	18	1,210.66
Small tools and misc.	2,013.11	0	
4 6-ton gasoline locomotives	18,880.00	20	3,760.00
40 roller bearing running gears	4,880.00	7	341.60
21,120 lin. ft. port. track 25 lb.	29,568.00	8	2,502.12
105 lin. ft. curved track	178.50		
9 complete half turnouts	1,530.00		
80 batch boxes	6,480.00	21	1,377.81
1 batch box bail	81.00		
	$112,304.20		$14,343.69

UNLOADING PLANT	
(Details omitted; same as items in corresponding schedule in Estimate "A")	$22,131.53
MIXING PLANT	
(Details omitted; same as items in corresponding schedule in Estimate "A")	$8,882.50
PUMPING EQUIPMENT	
(Details omitted; same as items in corresponding schedule in Estimate "A")	$5,469.44
FINISHING EQUIIPMENT	
(Details omitted; same as items in corresponding schedule in Estimate "A")	$4,533.49
BLACKSMITH, REPAIR AND MACHINE SHOP	
(Details omitted; same as items in corresponding schedule in Estimate "A")	$1,021.19
GENERAL EQUIPMENT	
(Details omitted; same as items in corresponding schedule in Estimate "A")	$2,022.65
CAMP EQUIPMENT SHEDS, ETC.	
(Details omitted; same as items in corresponding schedule in Estimate "A")	$6,725.90

HAULAGE EQUIPMENT

4 6-ton gasoline locomotives	$18,800.00	
40 roller bearing running gears	4,800.00	
21,120 lin. ft. portable track, 25-lb.	29,568.00	
105 lin. ft. curved track	178.50	
9 complete half turnouts	1,530.00	
80 batch boxes	6,480.00	
1 batch box bail	81.00	$61,517.50
		$112,304.20

LABOR

General superintendent (Less time at fine grading)	$3,200.00	
Timekeeper, 7 months	1,050.00	
Material clerk, 5 months	625.00	$4,875.00
Loading equipment at yard		
1 foreman, 15 days @ $7.00	$105.00	
10 men, 15 days @ $5.00	750.00	$855.00
Re-shipment to yard		855.00
Unloading coal and steel		
9 men, 10 days @ $5.00	$450.00	$450.00
Unload, haul, place and dismantle pipeline		
3 men, 120 days @ $6.00		2,160.00
General yard work and plant erection		
4 men, 12 days @ $5.00		$240.00
General plant labor:		
1 blacksmith, 5 mo. @ $200.00	$1,000.00	
1 helper, 5 mo. @ $150.00	750.00	
1 yard foreman, 7 mo. @ $140.00	980.00	$2,730.00
Camp labor—erection and operation: (Details omitted; same as items in corresponding schedule in Estimate "A")		$2,365.00
General labor: (Not including labor in nection with field repair) (Details omitted; same as items in corresponding schedule in Estimate "A")		$17,740.00
Covering and curing concrete:		
3 men, 110 days @ $5.00	$1,650.00	
1 watchman, 6 mo. @ $100.00	600.00	$2,250.00
Maintaining track and moving switches		
1 foreman, 110 days @ $6.50	$715.00	
6 laborers, 100 days @ $5.00	3,000.00	$3,715.00
Lay and take up 7 miles track		
1 foreman, 50 days @ $7.50	$375.00	
1 team, 50 days @ $8.00	400.00	
9 laborers, 50 days @ $5.00	2,250.00	
1 locomotive engn., 50 days @ $6.00	300.00	$3,325.00
Hauling		
1 trainmaster, 110 days @ $7.00	$770.00	
3 engineers, 110 days @ $6.00	1,980.00	
3 brakemen, 110 days @ $5.00	1,650.00	
1 engineer, 60 days @ $6.00	360.00	
1 brakeman, 60 days @ $5.00	300.00	$5,060.00

M—FUEL AND OIL

(Details omitted; same as items in corresponding schedule in Estimate "A")	$3,125.00
Hauling:	
Gasoline, oils and grease	$2,500.00

N—MATERIALS:

(Details omitted; same as items in corresponding schedule in Estimate "A")		$124,427.32
Cost estimate materials:		
Rock cost, ton	$1.75	
Freight, ton	1.00	
	$2.75x1.3—$3.575 per yard.	
Sand cost	0.50	
Freight, ton	1.00	
	$1.50x1.5—$2.25 per yard.	
Cement cost	2.50	
Material shrinkage and yard losses 2%		$2,488.55
Loss on cement sacks 2%x88,000 sacks—1,760 sacks @ 25c.		440.00

O—CONTINGENCIES

5% of $300,000. (Total price shown does not include any fine grading or any shoulder work.)

Estimate "C"—Fine Grading

EQUIPMENT INVESTMENT

1 10-ton steam roller	$5,800.00	
1 scarifier attachment	574.00	
1 10-ft. blade grader	1,080.00	
2 18-ft. templates	10.00	
2 slip scrapers	31.00	
1 heavy rooter plow	74.85	
50 ft. ¾-in. hose to sprinkle subgrade	13.80	
2 doz. round and sq. pt. shovels	34.00	
1 doz. grub hoes and picks	9.00	
1 doz. R. R. picks	9.00	
		$7,635.65

(Concluded on Page 118)

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

Founded January, 1892

E. L. POWERS
Editor

T. A. HULBERT
Managing Editor

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Cable Address: Gudrodes, New York

Copy for advertisements must reach the New York office by noon on Tuesday of the week before date of issue if proofs are to be submitted.

Copy for classified and other advertisements where proofs are not required will be accepted until noon on Monday of the week of issue.

Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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Vol. LXI August 31, 1921 No. 9

GRAVEL ROADS

"The Story of One Gravel Road," printed on other pages of this issue, is the story of many gravel roads.

Gravel is not classed as a high type of surfacing, nor are gravel roads generally considered "hard-surfaced" roads. Yet, under certain conditions, they are excellent highways—easy riding, cheaply maintained, of comparatively low tractive resistance when dry and smooth, and—what is particularly important in many localities—reasonable in first cost.

The total mileage of gravel roads is very large; it will be very large for a long time. Under present conditions gravel roads carry an immense volume of traffic; and for a good many years yet they will continue to do so. Therefore, it behooves highway engineers to take them into consideration and to look to their maintenance, for therein lies the secret—an open one, though—of their excellence.

For example: On one of the main routes to the Berkshires—one of the great playgrounds of the East—is a stretch of several miles of gravel road. It has been surface treated with bituminous material for several years and for a number of years after its completion it was kept in condition by the efforts of a workman who apparently spent most of his time on it. In the spring it was thoroughly overhauled and put into shape for the summer's traffic. All through the season of heavy tourist traffic it was scraped and dragged and raked—cared for continuously and carefully. As a result, it was as pleasant a road to ride over as could be desired.

Now the man has gone. The road is rough and rutty and if there were any other route it would be avoided.

We have no figures on the cost of maintaining that road, but it could not have been very much, as such things go. At any rate, the results obtained were easily worth several times the amount that the work done on it could possibly have cost.

It is no mistake to build gravel roads where the traffic and the available funds justify nothing better. It is a mistake to build a gravel road and then neglect it.

Marking Roads North Carolina is going to mark its highways, according to a recent news report. The erection of adequate road signs is only an incident of highway work, but it is one of the things that make friends for the state highway department that does it. It is gratifying to note that more and more attention is being paid to the marking of roads.

More Delay on Federal Aid Congress recessed Wednesday night without taking final action on federal aid, thus postponing for at least another month the settlement of a matter that already has been pending too long. If several different and apparently incompatible plans had not been advanced, definite action might have been taken several weeks ago. Without doubt, Congress and the country at large are "sold" on good roads, but the warring factions have been unable to compound their differences and act for the common good.

Printed Matter that is also Reading Matter From time to time, catalogs, bulletins, circulars and other printed matter issued by manufacturers of road machinery are noted in other columns. Engineers and contractors do well to obtain and read all matter of that kind that has any bearing on their work. It is a quite natural—and usually a fully warrantable—assumption that the maker of a machine knows more about it than does almost any one else. That being the case, what he has to say about what it will do is worth while.

Enforcing Motor Vehicle Laws New York State Troopers are making renewed efforts to curb reckless automobile drivers. Last week note was made of the efforts of the authorities of Maine and Massachusetts to put a stop to the practice of overloading motor trucks. Few existing motor vehicle laws are unduly severe, nor are the present laws enforced any too rigorously. All law-abiding citizens will approve heartily of the attempts made by the authorities to instill into the lawless and thoughtless a greater respect for the law and for the rights of others.

State Troopers Patrol New York Roads

The State Police of New York are active in enforcing the motor vehicle law. During one week troopers made 150 arrests in Monroe County. Loadometers are being used to weigh trucks suspected of overloading and many drivers of overloaded trucks are being fined.

Boston will Build Bascule Bridge

The City of Boston, Mass., will build a Strauss double-leaf, underneath counterweight type bascule bridge over the Mystic River at Chelsea St. The bridge will have two bascule spans, side by side, each having a span of 118 ft. between trunnions, carrying one trolley track, a 25-ft. roadways and a 5½-ft. sidewalk. In addition to the bascule spans, the bridge will have several fixed girder spans and will cost about $800,000. Plans are being prepared and it is expected to let the contract in the fall.

The Story of One Gravel Road

(Concluded from page 108)

Skeptics Converted by Government Standards

The standards of the Bureau of Public Roads governed all the construction, and the excellence of the work obtained made "good roads" boosters of even the most skeptical. Project No. 3 is typical of the kind of construction which will be needed in West Virginia for several years to come; and it is because of this project and other similar federal projects completed or placed under construction in the past three years that the road sentiment is as strong in West Virginia as it is today.

How strong that sentiment is may be judged from the fact that the "good roads amendment" to the state constitution, providing for a highway commission with real powers and authorizing the issuance of bonds up to $50,000,000, was carried last November by nearly 5 to 1. The overwhelming vote in favor of the amendment was a tribute to the efficiency of the present State Highway Commission, even while operating under the narrow constitutional limitations of the old law. The Legislature is now (March, 1921) at work drafting a new highway law, which codifies all the general road laws and embodies the provisions of the constitutional amendment. By 1922 West Virginia should be in the forefront of the states carrying on an intensive highway development program.

Whatever criticism may be directed against the federal aid law as it now stands, it can not be denied that it has been largely responsible for such a change in public sentiment as has occurred in West Virginia, and which is evidenced by the vote of 1920. It has established standards of construction and obtained them. It has put improved roads in counties that had never before had improved roads, and whetted their desire for more of the same kind. It is liberal enough to permit the economical type of construction. If the law had required so-called permanent surface construction, it would have been possible with the funds available to have built about 2 mi. of high type surface on Project No. 3. But what good does 2 mi. of such a road avail when 28 mi. are impassable four months in the year and the need is to cover the 30 mi. or none? The general improvement which has followed the construction of this project as a graded earth road with gravel surface bears witness to the soundness of the policy which has been very generally adopted in states like West Virginia, where slips are common and newly graded roadbeds do not become stabilized for several years.

Contractors' Cost Data on Concrete Paving

(Concluded from page 116)

A. DEPRECIATION			
Roller	$5,800@ 10%	$580.00	
Scarifier	574.@ 40%	229.60	
Blade grader	1,080@ 20%	216.00	
Tools	100%	181.65	$1,207.25
B. INTEREST			
Equipment	$7,635.65@6½%	$496.32	
Investment	2,000.00@3¼%	65.00	561.32
C. GENERAL OFFICE SUPERVISION			
$9,000.00@2%		$180.00	
Part contractor's salary		50.00	230.00
D. TAXES			20.00
D. WINTER EXPENSE			50.00
F. BOND			
$9,000.00@1½%			135.00
G. INSURANCE			
Public and Workman's Compensation $8,000.00@3%		$240.00	
Fire insurance, etc.		20.00	260.00
H. FREIGHT AND RY. FARES			
2 ways on roller		$100.00	
Miscellaneous		50.00	
Ry. fares		100.00	250.00
K. RUNNING REPAIRS			
Rolling flues, etc			500.00
L. LABOR			
General superintendent		$800.00	
Timekeeper		350.00	
1 engineer, 5 mos. @ $250.00		1,250.00	
Blacksmithing		300.00	
1 laborer, 100 days @ $5.00		500.00	
5 men, 100 at $5.00		2,500.00	
2 teams, 100 days @ $9.00		1,800.00	
Labor in moving		100.00	7,600.00
M. FUEL AND OIL			
Coal, 20 tons @ $7.50		$150.00	
Oil		40.00	
Haul supplies		50.00	240.00
N. GENERAL CONTINGENCIES			
5% $9,000.00			450.00
Total Cost			$11,503.57
Total yardage			73,920.00
Fine grading cost per square yard			$0.155

North Carolina will Mark Highways

Plans for the marking of the highways of North Carolina are now under way, according to C. M. Upham, State Highway Engineer, who has asked the district engineers to submit designs for markers. It is hoped that the work of placing the signs on the roads will be started early this fall.

Massachusetts and Connecticut Take Traffic Counts

The States of Massachusetts and Connecticut recently took traffic counts on various highways in cooperation with the Bureau of Public Roads and the National Research Council, which bodies have started upon an exhaustive study of highway traffic in this country.

Pennsylvania Railroad Gives Land to New Jersey for Highway

The New Jersey Public Utility Commission has approved the proposal of the Pennsylvania Railroad to give to the state four parcels of land for highway purposes. One tract of about one-fourth acre is in Rahway and the other three parcels, amounting to about two acres, are in Woodbridge Township.

Roads and Traffic in China

Motor Buses Operated Over Gobi Desert Replace Camels and Oxen Formerly Used

In Pekin the roads are suitable for motor traffic and are kept in satisfactory repair, according to the "Bulletin Officiel de la Chambre Syndicate des Constructeurs d'Automobiles." About 900 motor vehicles are in operation in Pekin. On the outskirts of Pekin about 50 km. of roads are suitable for motor traffic and a road connecting Pekin with Tientsin, a distance of 83 km., is under construction.

Between Kalgan and Ourga, a distance of 550 mi. in the Gobi Desert region, motor buses operate, making the trip in three or four days. Each car carries four passengers, each being allowed 14 kg. of luggage. The cost of the trip (one way) is $120. The Pekin-Suiyuan Railway and an American and a Chinese company all operate buses between Kalgan and Ourga. Before the use of motor vehicles, transportation was effected by camels or ox carts, requiring 40 days to make the trip. The tax on motor vehicles in Pekin is $4 per month.

About 40,000 push-carts with pneumatic tires are registered with the police of Pekin.

In Tienstin there are about 150 km. of road under construction and the roads, as a rule, are surfaced and suitable for motor traffic. The bridges carry vehicles up to six tons in weight. Taxes on motor vehicles are $2 (Mexican) per month, and seven are registered.

In the Shangai district there are 2,522 motor vehicles and 290 motor trucks, and while there are few roads, those that do exist are serviceable.

The Province of Kouang-Tong has few roads; even the footways for pedestrians are impassable at certain times of the year. Motoring is possible only in the town of Canton, where, during the past two years, about 30 km. of boulevards, 70 to 150 ft. (English) wide, have been macadamized. All these boulevards are on perfectly level ground.

To Build Bascule Bridge at Troy, N. Y.

A new reinforced concrete bridge with bascule span will be erected over the Hudson River between Troy and Cohoes, N. Y., to replace the one destroyed last year by the burning of its flooring.

The new structure will be 879 ft. long with a 26-ft. roadway and two 6-ft. sidewalks. The contract for the construction of the structure has been awarded to Terry & Tench Co., of new York City, at $567,000. The bascule span will be of the Strauss double-leaf trunnion type, 200 ft. in length.

Ouachita Parish, Louisiana, plans to sell $1,000,000 of 6% road bonds on Sept. 14.

Automobile Exports to Japan in 1920 consisted of 1,745 vehicles valued at $2,425,518 and parts valued at $2,798,141.

The Arkansas State Highway Department has divided the state into five districts and will appoint a resident engineer for each district.

By the Use of Motor Vehicles an annual market for 60,000 horses has been destroyed and demands for hay and feed reducing approximately $88,000,000.

Negro Road Laborers on a job near Benton, Ark., were recently driven out of the section by armed men because of resentment against the use of negro labor in the community.

A Bill Introduced in the Missouri Legislature gives cities and counties the power to acquire bridges by condemnation. This bill was introduced to make possible a free bridge at Kansas City over the Missouri River.

The State of Minnesota plans to spend $26,000,000 for road work this season, according to an announcement of the State Highway Department. This amount is made up of motor fees, federal aid funds and local assessments, together with about $5,000,000 of county bond funds.

MEETINGS

Calendar of Coming Meetings

Aug. 30-Sept. 1—Michigan State Good Roads Association.—Annual meeting, Flint, Mich. P. T. Colgrove, Pres., Hastings, Mich.

Sept. 7-9.—League of Virginia Municipalities.—Annual convention, Norfolk, Va. Secretary, L. C. Brinson, Portsmouth, Va.

Oct. 12-14.—League of Kansas Municipalities.—Annual convention, Lawrence, Kan. Secretary, John G. Stutz, University of Kansas, Lawrence, Kan.

Oct. 19-20.—North Carolina Good Roads Association.—Annual convention, Greensboro, N. C. Secretary, H. M. Berry, Chapel Hill, N. C.

Oct. 20-21.—Ohio State Conference on City Planning.—Annual conference, Columbus, O. Secretary, Charlotte Rumbold, Cleveland, O.

Oct. 24-28—American Society for Municipal Improvements—Annual Convention, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Nov. 14-16.—City Managers' Association.—Annual convention, Chicago, Ill. Secretary, H. G. Otis, City Manager, Clarksburg, W. Va.

Nov. 16-18.—National Municipal League.—Annual convention, Chicago, Ill. Secretary, H. W. Dodd, 261 Broadway, New York, N. Y.

Duluth Engineers' Club

The Duluth, Minn., Engineers' Club held its annual meeting on Aug. 2 and elected the following officers: President, W. A. Clark; First Vice President, R. S. Huey; Second Vice President, A. M. Frazee; Treasurer, W. E. Hawley; Secretary, H. P. Haseneye.

Fourth International Road Congress

At a meeting of the Permanent International Association of Road Congresses held on June 11 at Paris, the invitation from the Spanish Government to hold the fourth congress in Spain in 1923 was accepted. It had been intended to hold the congress in Italy this year, but the Italian Government felt that certain unavoidable inconveniences would be met if the congress were held in Italy. Consequently, the idea of holding the fourth congress in Rome in 1922 was given up.

Among the subjects that will be considered at the fourth congress are: Surfacing of roads with concrete; use of tar and asphalt for surfacing; the development of motor transport; general traffic regulations; the problem of traffic on congested roads and streets of towns.

The dues of the association were raised as follows: Private members, 20 francs annually; life membership, 200 francs; members who enter for one congress, 50 francs; government delegates, 250 francs; corporation delegates, 100 francs.

PERSONAL MENTION

W. W. McClendon has been appointed consulting engineer for Navarro County, Texas.

Fred O. Eichelberger, Director of Public Service of Dayton, O., has been appointed city manager.

G. H. Sykes has been appointed division engineer by the Arkansas State Highway Department, with headquarters at Little Rock.

W. C. Hight has been appointed district engineer by the Arkansas State Highway Department, with headquarters at Fayetteville.

C. L. Cravens has resigned as county engineer of De Soto County, Florida, and is now with the Florida State Road Department.

George C. D. Lenth has been appointed secretary of the Clay Products Association, Chicago, Ill., to succeed George H. Tefft, deceased.

Elbert B. Reynolds has been appointed district engineer by the Arkansas State Highway Department, with headquarters at Hope.

E. P. Arnold, formerly Assistant Office Engineer of the West Virginia State Road Department, has been appointed equipment engineer.

George H. Hill, formerly engineer of the First Division of the West Virginia State Road Department, has been made office engineer.

D. A. Grant, formerly with the Pennsylvania State Highway Department, is now general superintendent of Mayer Bros. Construction Co., Oil City, Pa.

Edward S. Smith, formerly engineer of the Fifth Division of the West Virginia State Road Department, has been appointed general inspector.

A. B. Fletcher, State Highway Engineer of California, is director of the California Department of Public Works under recent reorganization of state departments.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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*Illustrated article

Concrete Roads must be reinforced

It is demonstrated beyond doubt that to make concrete roads proof against heavy motor traffic, weather and time a fabric of steel must be incorporated in the concrete.

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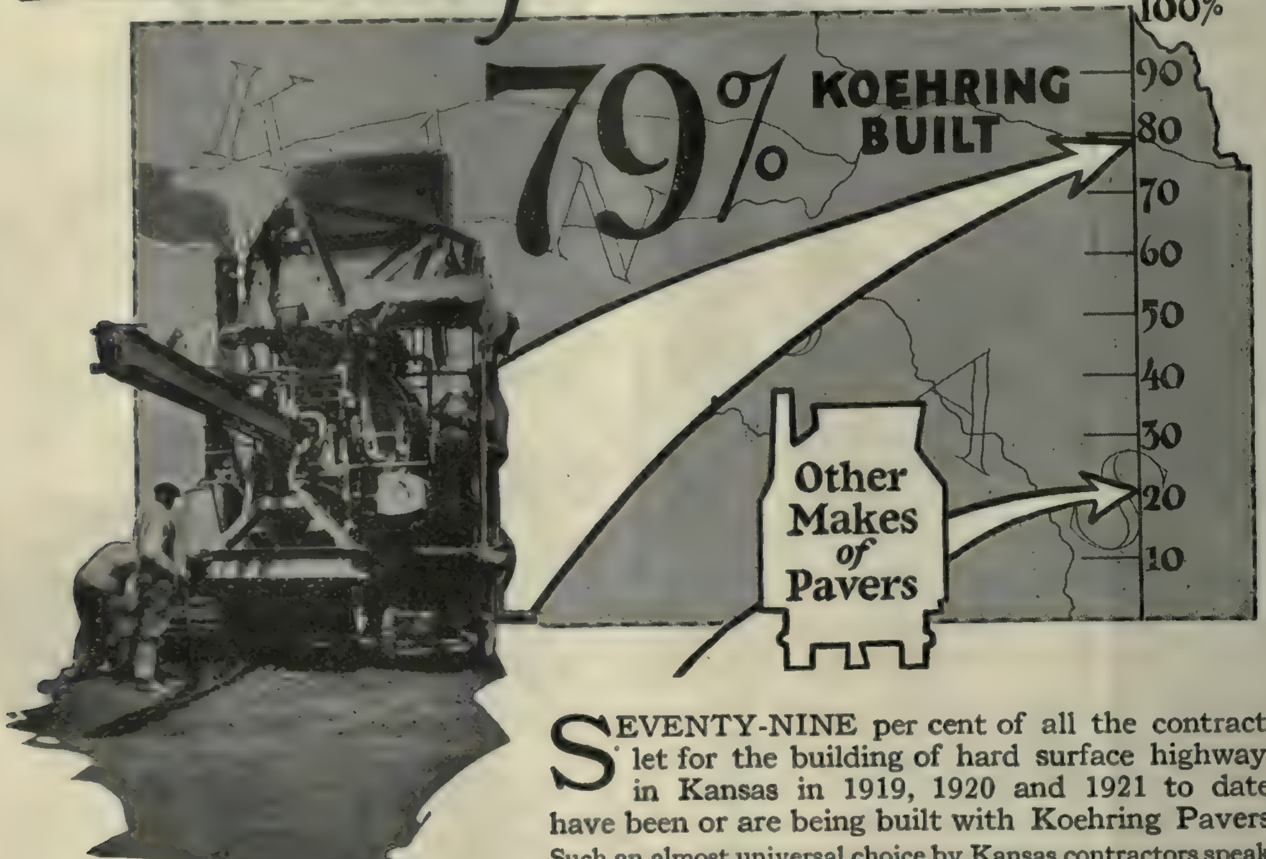

SEVENTY-NINE per cent of all the contracts let for the building of hard surface highways in Kansas in 1919, 1920 and 1921 to date, have been or are being built with Koehring Pavers.

Such an almost universal choice by Kansas contractors speaks more eloquently of the value and worthiness of Koehring Pavers than pages of advertising could possibly do.

Here are the statistics:

Total number miles of concrete road let to date in Kansas	181.349
Total number miles of brick road let to date in Kansas	60.043
Total mileage of hard surfaced roads let	241.392
Mileage paved or being paved with Koehring machines	191.309
Mileage paved or being paved with all other machines	50.083
Percentage of Koehring paved roads	79.249
Percentage of roads paved with all other machines	20.752

Of the 181.349 miles of concrete roads let, 137.224 miles, or 75.668% are Koehring built roads. And of the 60,043 miles of brick roads let, 54.085 miles, or 90.077% are constructed with Koehring pavers.

The customer is the final judge of worth. And 79% of the state hard road builders of Kansas back their judgment that the Koehring Heavy Duty paver is the paver of absolute dependability.

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GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE
WITH WHICH IS INCORPORATED
THE HIGHWAY CONTRACTOR AND ROAD BUILDER

Vol. LXI. NEW YORK, N. Y., SEPTEMBER 7, 1921 Number 10

Time of Set of Concrete---I [*]

Description of Method Applicable to Neat Cement, Mortar and Concrete—Effects of Consistency, Richness and Temperature on Time of Set—Effect of Character of Cement—Proposed Early Compression Test

By WATSON DAVIS[†]

ALTHOUGH TIME-OF-SET TESTS OF NEAT CEMENT are standard routine, a corresponding test for mortars and concretes has not been developed heretofore. This paper describes such a test, utilizing the "flow table."

CONCLUSIONS REACHED by testing according to the method developed by the author, with the apparatus described, are as follows:

CONSISTENCY, RICHNESS AND TEMPERATURE have marked effects upon the time of set. Wet mixtures, low cement content and low temperature cause slowness of set, while dry mixtures, high cement content and high temperature hasten set.

THE CHARACTER OF THE CEMENT ITSELF largely determines the setting properties of the concrete in which it is used. The "flow test" gives values slightly lower than the initial set determinations by the needle test.

AN EARLY COMPRESSIVE STRENGTH TEST say at 24 hours, is proposed as a substitute for the impractical final set needle tests of neat cement; and for determining when to pull forms and the like.

The "time of set" of concrete is an important property to which little attention has been given. Specifications for the time of set of neat cement, the principal active ingredient of concrete, have been formulated and used. Much investigational work has been done using the Vicat and Gillmore needle methods of measuring time of set of neat cement, and the literature is filled with reports of setting time tests of neat cements of "normal consistency."

But a measure for the setting qualities of concrete and mortar, the forms in which cement is used commercially, has not been developed heretofore. This paper presents a method, which may be called the "flow" method, for measuring time of set or rate of stiffening of concrete. Data and examples of its use in determining some of the principal factors influencing the setting of concrete are presented.

Method

Briefly, the method consists of determining the time at which the concrete ceases to "flow," or when it is no longer plastic. This is accomplished by using the "flow table," an apparatus developed at the Bureau of Standards for measuring the consistency or "flowability" of concrete.[1]

The "flow table" is a table-like apparatus consisting of a rigid frame with a top mounted on a vertical shaft so that it can be jolted or allowed to drop through a fixed height by means of a rotated cam. A mass of concrete, usually in the shape of a disk or truncated cone, is placed on this table top, jolted a given number of times, and its increased diameter measured by means of calipers. The diameter after jolting divided by the original diameter and multiplied by 100 gives a figure which is a criterion of "flowability" or consistency.

The flow test for consistency of concrete and the flow test for time of set of concrete are intimately connected. In the test for time of set, the rate of

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[*] Paper presented at the 24th annual meeting of the American Society for Testing Materials, Asbury Park, N. J., June 21-24, 1921.

[†] Assistant Engineer Physicist, Bureau of Standards, U. S. Department of Commerce.

[1] G. M. Williams, "Flowability of Concrete and Its Measurement by Means of the 'Flow Table'," "Good Roads," Aug. 18, 1920.

While the flow table apparatus as used in obtaining the data of this paper and as now used in other laboratories for testing the consistency of concrete was independently developed at the Bureau of Standards during the early part of 1919, it should be noted that Cloyd M. Chapman in U. S. Patent, 1,233,843, filed February 21, 1913, granted July 17, 1917, describes fully the principle that underlies the flow table. Claim 3 of his patent reads:

"The method of testing the consistency of plastic material which consists in molding the material to a definite size and shape, releasing the molded mass from restraint by the mold, and then subjecting the molded mass to a definite jarring, and measuring the increase which takes place in a lower horizontal dimension thereof."

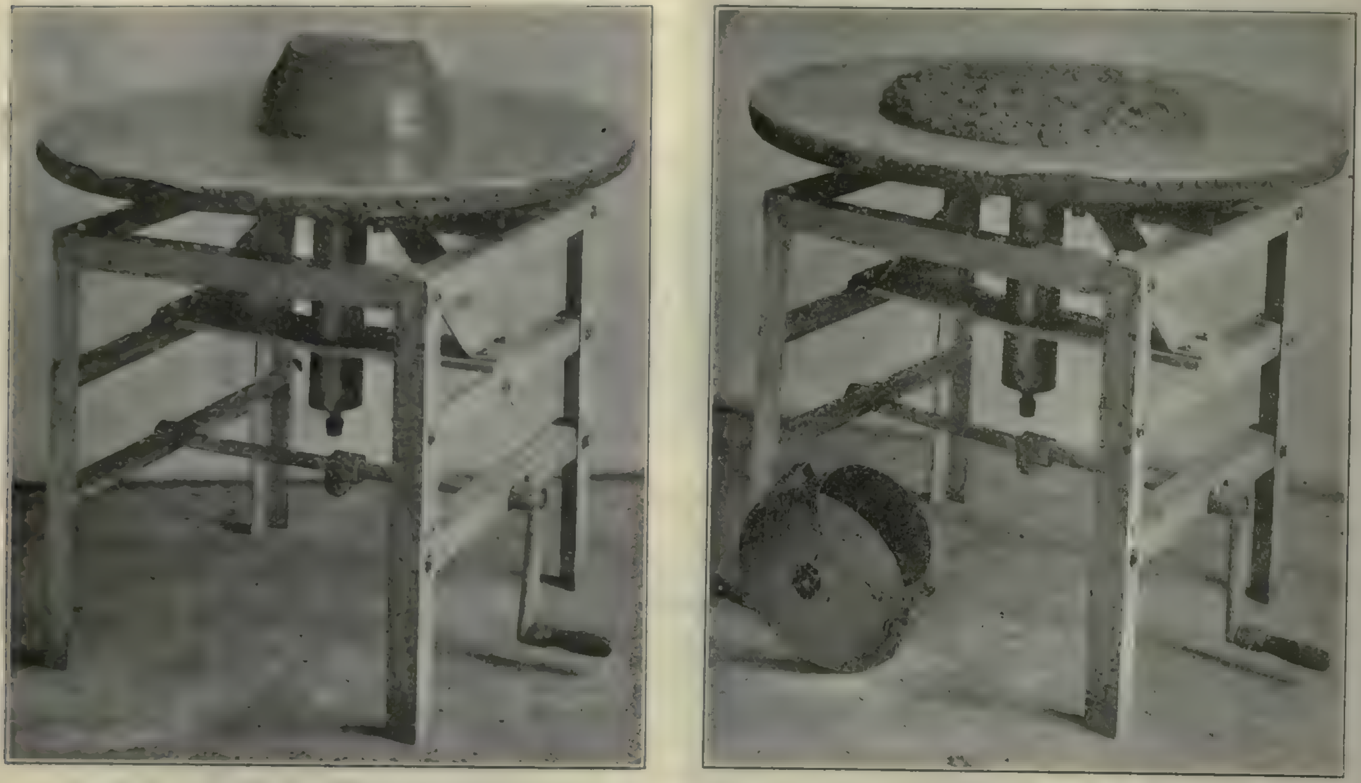

FIG. 1.—LARGE FLOW TABLE BEFORE AND AFTER START OF TEST

decrease in flow is measured as follows: A number of disks of concrete are molded and at stated time intervals after mixing are tested in succession for flowability. At the beginning of the test the disks are jolted at intervals of an hour, but the intervals between joltings are decreased as the flow decreases. As the concrete stiffens the flow decreases, and the time at which the point of no flow is reached is considered the time of the set of the concrete. In practice, a flow of 105 is usually considered the point of no flow.

Apparatus

Necessary apparatus for making the tests consists of a flow table and sufficient molds and calipers for measuring the spread of concrete on the flow table. Two sizes of flow tables were used. The large table (designated D) has a 36-in. top while the small table (designated C) has an 18-in. top. The former is illustrated in Fig. 1, and the latter is illustrated in Fig. 2. A cylindrical mold, 6 in. in diameter and

(Continued on page 129)

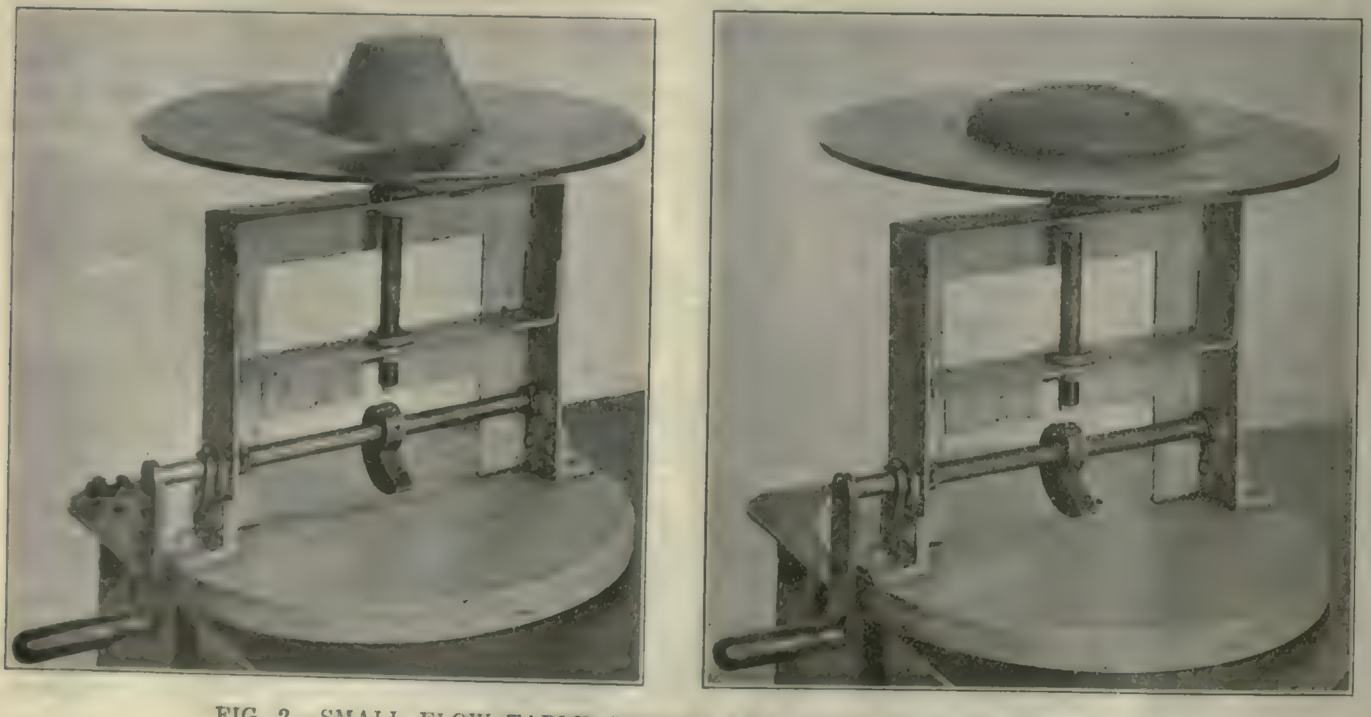

FIG. 2.—SMALL FLOW TABLE, BEFORE AND AFTER START OF TEST

Awarding Highway Contracts in the Fall

Advantages of Fall Lettings Far Outweigh Disadvantages, According to Findings of the Research Department of the Associated General Contractors and a Special Committee of Highway Engineers and Contractors, Reporting to Secretary of Commerce Herbert Hoover

Awarding road contracts in the fall instead of in the spring has been urged by engineers and contractors for some time. One of the reasons put forward by proponents of the plan is the employment of labor in slack seasons and another is the avoidance of so great fluctuation in the production of road materials. These factors of the problem have brought it under the official notice of the Departments of Commerce and of Labor, and Secretary Hoover of the former has lately interested himself in the matter. At his request, the Research Department of the Associated General Contractors prepared an analysis of the plan and submitted it to him some weeks ago. A memorandum on the same subject has also been submitted by a special committee of highway officials, engineers and contractors.

The Research Department's analysis gives the results of a discussion of the question with engineers and contractors in many parts of the country and discloses only two objections to the plan as against six advantages possessed by it. The objections, in the department's opinion, "may rightly be termed insignificant," while the advantages are characterized as "so far-reaching in effect that they cannot longer be ignored."

According to the findings of the special committee, engineers regard the prevailing practice of letting contracts in the spring as the cause of "an avoidable waste," and it finds that: "For many reasons," which are given in its report, "if road building contracts were let in the fall or early winter, these wastes would be avoided."

Analysis by the Research Department of the Associated General Contractors

The present practice of awarding contracts in the spring is blamed by engineers and contractors engaged in road work for "a vast amount of waste and inefficiency in highway construction, much of it avoidable," according to the department. Because of this practice, a large portion of the construction season is not utilized and construction companies are unable to complete the mileage warranted by their elaborate organizations.

The usual state highway department procedure, according to the department's analysis, has been to ask for bids in the spring—frequently as late as May. By the time the bids are in, many working days have been lost and before the contracts are awarded other delays have occurred, the combined loss of time often amounting to as much as 14 weeks.

"The average number of working days in the central states under spring letting," the analysis continues, "has been found to approximate from 110 to 120, and since the 14 weeks lost contain from 25 to 30 days on which weather conditions permit work, the season might readily be increased 20%. In other words, with an early start, road building units can operate 140 days in the year instead of 115."

The case of Illinois in 1919 and 1920 is cited as an example of the delay incident to spring letting. In 1919 the first Illinois contracts were awarded early in May and but little concrete was placed previous to July. Thereafter production increased steadily until October, when it reached the maximum. A week later it dropped off rapidly—to zero. Because of the delay in attaining maximum production, only 172 mi. of roads were built, while about 600 mi. were carried over to the following season. In 1920, because of the large amount of work carried over, conditions approximated those that would obtain under fall lettings. This enabled the contractors to make an early start and to begin concrete work in April, two months earlier than the year before. By June, it had reached a heavy volume and had there not been a failure of transportation, "the indications are that peak production would have been reached in July and continued with slight fluctuations until October."

The analysis then takes up in detail the advantages and disadvantages of the plan of fall lettings. The full text of the remainder of the analysis follows:

Disadvantages of Fall Letting

To determine the full effect of abandoning the present custom of spring lettings, discussion of the subject has been carried on with engineers and contractors in many parts of the country. This discussion, which has brought out two objections to such a plan, shows six advantages which would accrue to the construction company, the workmen and the state. The objections are: First, in a declining market the state would pay more for work under fall contracts than those awarded the following spring; and, second, the highway departments need a slack season in which to make surveys and plan their projects for the coming year.

Prospects of a rapidly falling market must undoubtedly be considered in letting work, although by the same principle spring contracts might well be withheld for lower prices in the following fall. When prices are practically stabilized this consideration, of course, would not enter and the economies otherwise effected would probably outweigh any minor changes in material prices. The second objection pertaining to the need of highway departments for a slack season in which to plan and make surveys, was not considered serious by the engineers consulted, as they felt that state departments might readily readjust their organizations to handle the work, and especially so, since the process would probably reduce the engineering charges per mile of road. Unless more serious obstacles to fall letting are found, the objections may rightly be termed insignificant.

Advantages of Fall Letting

The advantages, on the other hand, are so far-reaching in effect that they cannot longer be ignored. They are as follows:

1. Relief of car shortage between July and October.
2. Employment of labor in slack months.
3. Reduction of seasonal fluctuation in construction.
4. More continuous production of materials.
5. Increased efficiency in road building.
6. Completion of highways as planned by state departments.

1. Relief of Car Shortage

Transportation, the first factor mentioned, constitutes probably the most difficult item with which road builders have to contend. Its failure in 1920 cost them many thousands of dollars and if any means is found whereby a steady supply of materials can be assured, great economy will be introduced. Such a means can, at least in part, be furnished by beginning work early in the spring—thus starting the movement of materials at an early date and reducing the peak demand for open top cars in late summer. It was this peak demand, contributed to by all industry, which disrupted construction in 1920.

One of the most difficult problems with which the railroads have to contend in the United States is the transportation peak load, occurring between June and October. Much traffic is seasonal, of necessity, and much other which might easily be handled earlier in the year, places upon the carriers during these months a load which they are scarcely able to carry. In 1920 the situation became so acute that many shippers, especially material manufacturers, were able to secure but a small portion of their needs. The reasons for this situation and the danger of its recurrence are shown by reports of the carriers.

In 1917 the Class 1 carriers had about 2,479,000 freight cars in service, but by 1920 this number had decreased 126,000 with 310,000 cars in bad order. Recent reports from the carriers show that they now have 134,000 cars less than at the transportation peak of 1920. Therefore, it is essential that every industry take action, wherever possible, towards relieving the congestion of late summer. Such action would greatly aid the carriers and enable them to give better service to all shippers.

If contracts were awarded in the fall, construction companies could not only give aid in the transportation problem by making certain shipments in winter and spring, but could also give continuous employment to a part of their employees.

2. Slack Season Employment

On account of the seasonal character of construction, which is one of the most seasonal industries, each year witnesses an enormous fluctuation of activity. In those states which are not favored by a mild climate, an elaborate organization is assembled in the spring and a few months later is scattered as work closes down in the fall.

Workmen thrown out of employment by the closing down of construction must seek employment in other industries at a time when other industries do not need them, and under the best of conditions they lose a great amount of working time. This lack of employment is in part accountable for much of the turnover between construction and other industries. Any action whereby more continuous employment can be furnished will doubtless draw more competent men into construction and raise the efficiency of those already so engaged.

Construction companies could, if awarded contracts before winter, so lay out and execute their preliminary work that winter employment could be given to a considerable number of men. Heavy grading could be carried on, materials could be stock piled to insure a continuous supply, and material distribution plants could be assembled. In this way the preliminary work could be completed before concreting weather arrived, and capacity output could be reached early in the season. Each part of the work that can thus be carried on during the off-season helps to stabilize construction activity.

3. Seasonal Fluctuation in Construction

Elimination of the waste in any industry which results from spasmodic or heavy peak demands for production has for many years been the subject of careful study by public service and other corporations, but until very recently, the same factors in the construction industry have received but scant attention. And yet it is doubtful if any other industry offers a more fruitful field for improvement in peak load in efficiency.

Construction activity in the central and northern states must, on account of climatic conditions, be subject to wide variations. But even in those states the amount of work that can be performed outside of the period now commonly regarded as the construction season, is sufficient to materially reduce the almost feverish activity of late summer and autumn, and by such reduction to affect the economies which arise from more uniform operation.

Both engineers and contractors have learned that a great deal of construction formerly held until late spring can be safely and economically executed during the off-season. In fact, the last three years have witnessed a great amount of reinforced concrete building carried on through the severest weather. This of course, is not advocated in the case of concrete road construction, but there is, however, a great part of the preliminary and indirect work of highway building which could be completed during the winter and early spring months if contracts were awarded in the fall of the year.

4. Continuous Production of Materials

Seasonal fluctuations occur not only in the construction industry itself, but in the basic industries supplying its materials; and, in general, any benefit which accrues to construction reacts also to the benefit of the basic industries. Their problems of labor supply and overhead are almost alike. By lengthening the construction season the operating season for various producers of material is also increased. Two months added in the spring to construction would mean also two months added to the season for producers of gravel, crushed stone, and brick. Their overhead cost would be reduced accordingly and would reflect in the cost of finished roads. Material producers, like construction companies, would be better able to anticipate the market, provide for equipment and lay plans for adequate production.

5. Increased Efficiency in Road Building

Through the combined influence of all factors affected by fall lettings, a general reaction toward efficiency in construction would ensue. More efficient operation is now being studied by many engineers who have taken up contracting as a profession, and their discussion has shown a number of places where improvement is needed.

To begin with, considerable heavy grading can be done between the months of November and April, thus enabling a construction company to retain the nucleus of a permanent field organization. These men could be utilized also at other preliminary work to eliminate much of the dead time in winter during which the permanent field organization draws pay. Another saving can be made in equipment expense. Contractors, upon completion of their work in the fall, would not find it necessary to remove their equipment, ship it to the storage yard and then reship it in the spring, but could ship direct to new work. The freight of at least one shipment, and loading expense involved, are in that event eliminated.

Probably the greatest improvement is made possible by the opportunity offered for careful investigation and planning during the slack winter months, and the possibility of retaining a larger number of well trained men. One of the most common causes of inefficiency upon the part of construction organizations during the past year has been the lack of skillful mechanics to operate and maintain the specialized road machinery now in use. Inexperienced workmen have frequently broken machines which delayed operations of the entire plant. Any plan whereby construction companies will be enabled to retain mechanics and instruct them over winter will react to increase efficiency. Such a plan can be put into effect if contractors know in the fall what work they will have on hand the following spring.

6. Completion of Highways Planned The efficiency of a road building unit, while of interest to the state highway engineers, is not their most vital concern. They are interested first in seeing that the state receives the road which it contracted for and receives it on the date expected. Very few contracts in the last two years have been completed on time. If the conditions of 1920 in Illinois could be approximated in other states—that is, if work could start without the usual delay of spring letting—several contingencies of construction would be avoided and the various highway departments would doubtless be able to carry out their work as planned. The opinion has been expressed by engineers of the Illinois Division of Highways that, had the material supply not failed, it would have been possible with the early start of 1920 to build twice the mileage constructed that year and build it, moreover, without additional administrative charge and with very little additional overhead expense to the constructors.

Illinois thus gives evidence of the advantages which accrue from an early start in the spring, and their effect upon the volume of work performed. The conditions anticipated by engineers and contractors have been so closely verified in that state under conditions assimilating fall letting that its advantages are no longer to be doubted. Therefore, in order that the future road building program of the states may be carried out as planned by their engineers, that the economic losses of 1919 and 1920 may not be repeated, and that further reduction in the cost of roads may be brought about, it is proposed that the matter of fall letting be placed before all state highway departments as soon as possible. To insure the widest consideration possible, the question should also be placed officially before the American Association of State Highway Officials.

Memorandum Submitted by the Special Committee of Highway Engineers and Contractors

The special committee of highway officials, engineers and contractors consisted of George P. Coleman, State Highway Commissioner of Virginia; R. M. Gates, District Manager, Lakewood Engineering Co.; W. K. Hatt, Director of Highway Research, National Research Council; R. C. Marshall, Jr., General Manager, Associated General Contractors of America; Thomas H. MacDonald, Chief, Bureau of Public Roads, U. S. Department of Agriculture; Wm. D. Uhler,, Chief Engineer, Pennsylvania State Highway Department; and L. W. Wallace, Secretary, Federated American Engineering Societies.

In general, the findings of this committee parallel the recommendations of the Research Department of the Associated General Contractors. The conclusions reached are as follows:

> In general, fall letting of highway construction contracts will
>
> 1. Reduce present unemployment.
> 2. Eliminate seasonal wastes.
> 3. Tend to stabilize this branch of construction industry.

Pointing out that in most states it is customary to let road building contracts in the spring, the memorandum states that the practice "is credited by engineers as being an avoidable waste" and that if the plan of fall letting were adopted "these wastes would be avoided."

The letting of contracts in the fall, it is held, would release road construction funds in towns and cities, besides taking care of federal aid funds allotted to the various states. The report continues:

The advisability of awarding contracts in the late fall or early winter has been an open question for several years, but since the experience of 1919 when a major portion of the country's hard-surfaced highway projects was carried over incompleted to the following year, the plan has been generally favored. The Bureau of Public Roads has encouraged early letting and in a letter from the Chief of the Bureau, Mr. Thomas H. MacDonald, to the state highway departments in October, 1919, its opinion was expressed as follows:

> Contracts should be awarded as early as possible that the contractors may know the amount of materials they will require at different points, and they should be encouraged to place their orders for materials requiring rail transportation as far as possible in advance of the time they will be actually required * * * From the experience of this year, and in view of the greatly increased program of next year, it seems apparent that contracts which are not awarded during the winter months will have little opportunity of being supplied with materials which require rail hauling.

Transportation service for delivering materials is the difficulty pointed out in the bureau's approval of fall letting, but this is only one of several factors which the plan affects. These factors, later treated in detail, have an important economic influence upon highway building as an individual industry and upon other industries which are related to or participate in construction. They are the direct result of establishing first, a longer construction season, and second, the possibility of doing interseasonal work.

I. A Longer Construction Season

In the middle west in the spring letting there were 142 working days for grading and 104 working days for concreting, compared with the longer time in fall letting, of 207 working days for grading and 142 working days for concreting.

The difference in production cited discloses three principal advantages which may be obtained through a longer working season. These advantages are:

(a) Better car service.
(b) Less fluctuation in construction.
(c) Completion of highway programs.

Detailed explanation of these items is given in the following paragraphs:

(a) Better Car Service One of the most vital factors of highway cost has been found by road builders to be continuous transportation. The Bureau of Public Roads in addressing state highway departments has said:

> Railroad transportation has become too important a factor in the amount of work which can be accomplished to allow it longer to be regarded as incidental. It has become the biggest item in road production.

A late start in the spring has been found to make the greatest demand for transportation in that industry coincide with the peak demand for transportation in numerous other industries and some action is needed to make the demand more uniform. In the present condition of the railways their equipment would be inadequate to meet this demand, if the country's industries were operating normally. Recent reports from the American Railway Association show that the carriers now have 134,000 cars less than at the transportation peak of 1920. In order that shippers may be served satisfactorily it is necessary to reduce the maximum demand by separating the peak loads of various industries.

Mr. Daniel Willard, President of the Baltimore & Ohio Railroad, said in regard to early shipments:

> I am inclined to believe that the railroads with their existing facilities could perhaps handle all the business offered during a twelve months' period providing it were offered uniformly throughout the entire period but that of course is exactly what does not happen and it is certain that the railroads with their present facilities are not able to take care of the possible peak loads, and this is why I think it wise to urge upon all who can do so to ship now.

A start two months earlier in the spring would bring the peak demand for construction transportation that much earlier and would utilize many of the cars now idle at the beginning of each season. Therefore, it may be said that any means whereby the peak demand of late summer can be reduced will afford better transportation service for all shippers. The experience of Illinois would indicate that such a means has been found in the early start afforded by fall letting of contracts.

(b) Less Fluctuation in Construction To seasonal fluctuations is attributed a large amount of waste in the construction industry. On account of the speed with which work must be prosecuted to produce a reasonable return on invested capital during a short season, construction companies find it necessary to employ larger equipment units than would otherwise be required. Thus the equipment expense itself is higher and since it must finally be borne by the total number of units built the unit cost increases as seasonal output becomes smaller.

Another consideration is the more or less indeterminate expense of peak production. Work carried on through periods of extreme fluctuation is ordinarily attended by various expenses uncommon to uniform production and it is generally accepted that as uniformity is approached these somewhat intangible expenses decrease. This principle in some degree applies to road building though to what extent is uncertain. A flattening of the production peak similar to that of transportation demands is anticipated under the longer season afforded by early awards.

(c) Completion of Highway Programs Two months added to the present season will increase the working time approximately 25% and with it the seasonal output. This increase, combined with constantly improving methods of handling material, will in all probability assure the highway departments a satisfactory mileage of roads.

Projects carried over from 1920 in Oregon have produced a condition similar to that obtaining when contracts are awarded in the fall, and in that state, according to press reports, the State Highway Department asserts that construction at present progress will complete all contracts carried over and practically all of the new work.

Illinois also gives evidence of the advantages derived from a similar situation in 1920. The opinion was expressed by the Illinois Division of Highways that, "had the material supply not failed, it would have been possible with the early start of 1920 to build twice the mileage constructed that year, and build it, moreover, without additional administrative charge and with very little additional overhead expense to the constructors."

II. Interseasonal Work

Interseasonal work under the present system of awarding contracts has not been feasible, but opinions obtained from various associations representing several hundred construction companies have indicated that they could perform certain operations if they knew definitely in advance what work they would undertake in the spring. The advantages of such work as pointed out by the contractors and material producers consulted are:

(a) More continuous employment of labor.
(b) More uniform production in basic industries.
(c) More efficient organizations.

Detailed discussion of these considerations is given in the following paragraphs:

(a) More Continuous Employment of Labor Under present conditions, road building organizations, with the exception of a few permanent employees, are assembled in the spring and released in the fall as work closes. Probably 20 or 25% of these men could, through careful planning, be carried over winter instead of being released at a time when other industries do not need their services. The contractors have stated that heavy grading could be carried on, materials could be stock piled, equipment could be repaired and the material handling plants could be set up ready for work at the first opening of spring.

This field of interseasonal work coordinated with other types of construction activity and with other industries will contribute efficiency to the reduction of seasonal employment.

(b) More Uniform Production in Basic Industries To the basic industries which supply materials, the early spring and interseasonal work of road building affords an opportunity for more continuous production. Their problems of seasonal delivery are practically the same as those of a road building company and in general any benefits which accrue from fall letting are shared by the related industries, in that they afford the same opportunities to organize and develop production which is given the construction company.

Producers of sand and gravel have repeatedly urged that contracts be awarded early so that they might lay plans for an adequate supply of materials. Mr. E. Guy Sutton, Manager of the National Association of Sand and Gravel Producers, who has investigated the subject from the standpoint of the producers has stated that: "Fall letting would increase their season at least two months, would make a certain amount of seasonal work possible and as a result of these things would effect a reduction in production costs."

In many districts the interseasonal work afforded employees of the construction company in storing aggregates and providing for distribution, will call upon the material producers for stores of material. In some districts this will mean continuous operation of the basic industries, such as sand, gravel and stone, and in others will mean a

(Concluded on page 132)

GOOD ROADS
CONSTRUCTION TRANSPORTATION MAINTENANCE

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Copy for classified and other advertisements where proofs are not required will be accepted until noon on Monday of the week of issue.

Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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FALL LETTING VS. SPRING LETTING OF HIGHWAY CONTRACTS

The consensus of opinion among contractors—at least insofar as the opinion of the Research Department of the Associated General Contractors can be taken as a criterion—favors the letting of highway contracts in the fall instead of in the spring.

Practically the same views are held by the representative committee of engineers and contractors, the memorandum of which is noted and quoted elsewhere in this issue, with the report of the Research Department to Secretary Hoover.

On the other hand, the plan of fall letting has strong opponents.

The representative of an association of highway contractors in one state, for instance, holds that fall lettings are good for "cost plus" contracts, for "sluggish" engineering organizations and for contractors who want to "gamble with the future." He argues that letting contracts in the fall instead of in the spring will introduce an element of uncertainty with respect to prices and deliveries that will result in bids high enough to cover the contractor and, therefore, unduly high costs to the public.

Another opponent of fall lettings, a prominent state highway official, charges that the "propaganda" for fall lettings was inspired by the Associated General Contractors, who wanted the work.

Like all other questions, that of fall lettings has two sides. There are obvious advantages in awarding contracts in the fall and there are manifest disadvantages. Much has been said on both sides of the question, but it seems to be still open for discussion.

Preparedness Within a few months the roads in some of the more northerly states may be snow covered. Any considerable accumulation of snow—and there may be one by Thanksgiving—will have to be cleared away if traffic is to continue unimpeded. It is none too early now to begin to lay plans for keeping the main roads open during the coming winter.

More Machinery, More Profit An instance of how labor saving machinery increased a contractor's profits on road work is cited on another page of this issue. There are plenty of other similar examples. Road building and road maintenance are more and more becoming matters of machinery, and other things being equal, that contractor will be the most successful who makes the greatest and wisest use of labor saving equipment.

Bridge Fires Bridge fires resulting in more or less heavy damage are of very frequent occurrence—in fact, apparently of unusually frequent occurrence. America's annual fire loss has long been a reproach and a needless economic waste. No effort should be spared by designers of highway bridge structures to put their work in a different class from that of other builders. Transportation is too important to the country's industry and commerce to be handicapped by the temporary interruption due to burned bridges.

"Rural" Roads What *do* the British use for surfacing their "rural" roads? In reviewing Professor George R. Chatburn's recent text, "Highway Engineering: Rural Roads and Pavements," the London periodical, "Municipal Engineering and the Sanitary Record," says "Inasmuch as the subtitle of this book is 'Rural Roads and Pavements,' it might be assumed that the text is confined to a description of their construction and the principles underlying them. Such, however, is not the case, for some of the best and most comprehensive chapters are descriptive of the making and laying of pavement foundations, brick, stone, wood and other block roads, concrete roads, bituminous roads, and surface treatment to mitigate and prevent dust." Doesn't our contemporary across the big water realize that " concrete roads, bituminous roads, and surface treatment to mitigate and prevent dust" are as common on our rural roads as the farmers' gas buggies that travel over them? By implication, at least, the British reviewer denies to the "rural" road about every kind of surfacing except plain dirt and gravel.

New Jersey Allots Road Funds

At a recent meeting of the New Jersey State Highway Commission it was decided to distribute the money from the motor vehicle fund for 1922 to the counties according to area, population and mileage of improved roads.

Ohio Towns Will Display Name Signs

Through the efforts of the Ohio State Automobile Association, the Postmaster General has issued orders that the names of towns shall be shown on signs at all rural post offices. There are about 60,000 village post offices in the country affected by this order.

British Seek Bridge Contract

The Philadelphia, Pa., Chamber of Commerce has received a letter from the British Empire Chamber of Commerce asking for detailed information on specifications and the time when bids will be called for the bridge over the Delaware River between Camden and Philadelphia. This bridge will be erected by the States of Pennsylvania and New Jersey.

Alabama Must Issue Road Bonds

If the State of Alabama is to receive the benefit of $1,500,000 of federal aid now available, it must issue bonds to meet the allotment of federal funds, according to W. S. Keller, State Highway Engineer. All funds available and due Oct. 1 have already been pledged and the state is no longer able to match 25% with a similar amount from counties to meet federal aid.

Texas Road Bill Runs the Gauntlet

The road patrol bill introduced in the Texas Legislature by Senator Davidson, has passed both houses and has been sent to the governor. As originally introduced, the bill provided that the counties should select patrolmen to maintain designated sections of roads. In both houses of the Legislature the bill was amended so as to exempt over 200 counties of its provisions; as finally passed the bill applies only to about 30 counties.

Bridge in Boston Damaged by Fire

Fire in the woodwork under the roadway of the Dover Street Bridge between Boston, Mass., and South Boston, did considerable damage to an 80-ft. deck plate girder span of the structure. Under the granite block paving there is a 4-in. spruce planking and a wooden walk for repair purposes was strung under the bridge. The burning of these buckled the stringers and floor beams to such an extent that the span must be rebuilt.

Labor Body Urges Road Construction

The Executive Council of the American Federation of Labor has issued a statement calling upon the Federal Government and the states to relieve unemployment by the construction of roads and other public works.

The U. S. Bureau of Labor, in accordance with a resolution passed by the Senate on Aug. 5, has compiled an estimate of unemployment in the country. In the report issued Aug. 16, the bureau places the number of unemployed in the country at 5,735,000, being based on differences in number of employees carried on payrolls of this year as compared with last year.

Road Plans of West Virginia

Bankers of State Refuse to Buy Highway Bonds for State System of Roads

Although the State of Virginia has authorized the issuance of $50,000,000 of road bonds, difficulty is being experienced in marketing the first instalment of $15,000,000. At a meeting of state bankers on Aug. 20, called by Governor Morgan, the bankers stated that they would be unable to take the bonds; however they offered the suggestion that the bonds be sold under a plan similar to that in Liberty Loan campaigns.

A map has been prepared by the State Highway Department designating the roads to be included in the state system of roads to be improved. These roads connect the county seats in the state and also connect with the main highways in neighboring states

Appoint Engineers on the Delaware Bridge

Dr. Paul Cret of University of Pennsylvania Appointed Architect of Structure

At a meeting of the Delaware River Bridge Joint Commission, Dr. Paul Cret, of the University of Pennsylvania, was appointed architect at $5,000 per year.

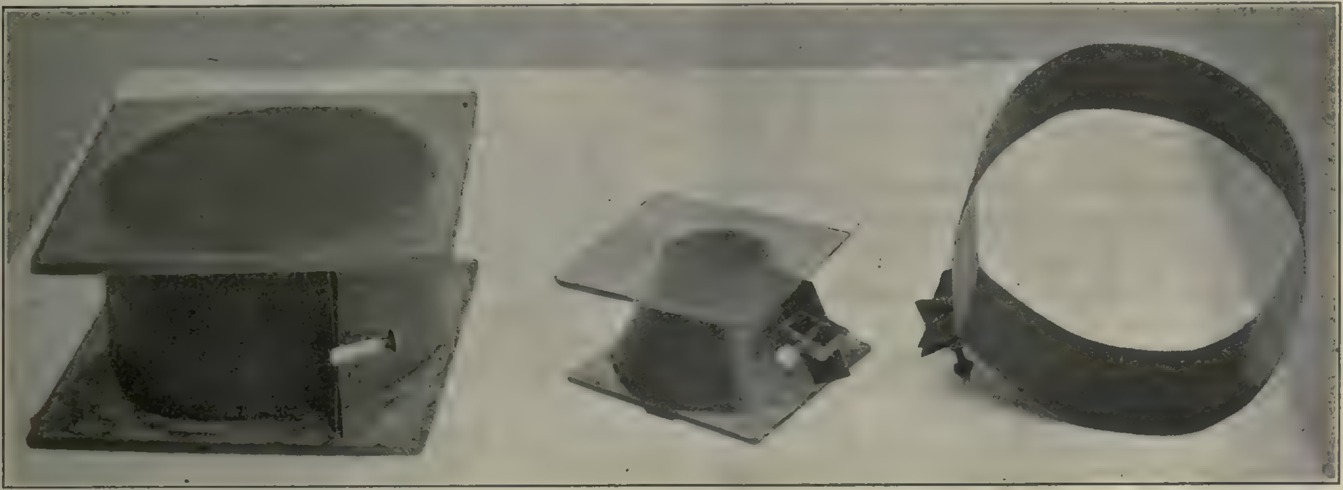
The contract for making 32 borings to get samples of the earth formations was awarded to the Pennsylvania Drilling Co., Pittsburgh, Pa., at $13,815, the lowest of six bids.

Assistant engineers, with monthly salaries as noted, were appointed as follows: R. E. Anthony, Assistant Engineer, $200; Charles W. Armstrong, Assistant Surveyor, $150; E. W. Bowden, Junior Engineer, $125; Charles Carswell, Junior Engineer, $150; Allston Dana, Assistant Designing Engineer, $350; Clinton Davis, Assistant Engineer, $250; E. S. Fisher, draftsman, $225; George Halvas, Assistant Engineer, $200; William K. Henkels, Draftsman, $175; Frank S. Kiefer, Assistant Surveyor, $175; A. W. Munsell, Assistant Engineer, $200; David H. Plank, Draftsman, $225.

Time of Set of Concrete

(Continued from page 122)

3 in. high, made of light sheet metal bent into cylindrical shape and fastened with a small clamp, was used for tests on Table D. For use in some tests on Table C, a smaller mold in the shape of a truncated cone—the shape usually used for flow tests for consistency—was used. This mold, also made of sheet metal similarly fastened, measured 4 in. in bottom diameter, 2 in. in top diameter and 2 in. in height. These are shown in Fig 3. A small disk mold 2 in. diameter, 1 in. high, was used for molding test specimens for the neat cement tests. Except when indicated, Table D had a ½-in. drop and was jolted 15 times, and Table C had a ½-in. drop and was jolted 50 times. Although the actual figures for flow are influenced by the flow table and molds used, the setting times determined are not materially affected. The time of set is taken as the time at which the concrete will not flow when jolted, and set concrete cannot be made to flow by more vigorous jolting.



MOLDS USED IN FLOW TABLE TESTS OF CONCRETE

(To be continued)

Oppose Hudson River Pontoon Bridge

Engineers and Rivermen Maintain that Bridge Would Be a Menace to River Traffic

At a public hearing in New York City on the proposed pontoon bridge over the Hudson River between Yonkers, N. Y., and Alpine, N. J., clashing opinions on the project were expressed by Gustav Lindenthal and William H. Burr, both bridge engineers of note. A bill is now pending before Congress to authorize the construction of this bridge, it being planned to utilize wooden vessels of the Shipping Board.

According to Gustav Lindenthal, who designed the bridge, there would be no danger from ice in the river, at it does not come down in sheets and further, three boats would be maintained to break up the ice. The chief danger, he said, would be from fire. Wind pressure would be taken care of by screw piles driven into the bottom of the river and by steel cables running to them from the bow and stern of each boat. The draw span would be 270 ft. in length and a clearance of 40 ft. for a distance of 270 ft. would also be provided.

Mr. Burr insisted that ice would sweep down the river and carry the proposed bridge away, critizing the stability of the pontoons and the security of the screw piles to which the cables are to be attached. The bridge would constantly be moving and could not carry traffic for ten years, the proposed life of the structure.

Captains of river steamers stated that winds of 50 to 60 mi. per hour are common, which would make it dangerous for vessels to pass the 270-ft. draw. Towboat skippers stated that the number of vessels towed would have to be reduced to pass the bridge, thereby causing higher freight rates because of reduced capacity.

English Railroads Want to Develop Auxiliary Motor Service

The committee appointed by the British Ministry of Transport to study the feasibility of railroads engaging in motor transport has rendered three separate reports. The first report recommends that the railroads be permitted to engage in this form of transportation under certain restrictions; the second report does not favor the extension of the railroads' facilities, while the third suggests that this plan be tried out in limited areas.

A Light Automobile that will jump over obstacles not more than 3 ft. high has been invented by a Frenchman.

Bradley County, Arkansas, is being sued for $6,000 by H. R. Carter, an engineer employed for work in two road districts. The State Legislature repealed the act creating these two road districts after Carter had made surveys and prepared maps.

EQUIPMENT---TRADE---MATERIALS

Labor Saving Machinery Adds to Contractors' Profits

The paving specification of Lucas County, Ohio, permit the saving by the use of a tamper of ¼ bbl. of cement to each cubic yard of concrete, thus putting in tangible form one of the many savings effected by labor saving machinery in road work. The following two paragraphs are taken from the road specifications of Lucas County:

> The proportions used, unless otherwise shown on the detail plans, shall be by volume approximately one part of cement, one and one-half parts of sand and three parts of stone. Concrete of the above mentioned proportions shall in no case contain less than 1.85 bbl. of cement to the cubic yard.
>
> When machine finished concrete is employed these proportions may be changed to approximately 1 : 2 : 3½, and in this case a cubic yard of concrete shall contain not less than 1.6 bbl. of cement.

In one of the illustrations an Austin tamping machine is shown, finishing concrete hauled from a central mixing plant 4 mi. distant.

The other illustration shows an Austin paver at work on a contract held by Bates & Rogers for a section of the Cleveland-Akron Highway, 17.5 mi. in length. The pavement laid is reinforced concrete, 18 ft. 4 in. wide, 8 in. thick at the sides and 10 in. at the center. In the work on this section, it is of interest to note the variation in daily footage, the same equipment being used throughout the job.

AN AUSTIN PAVER HELPED TO DOUBLE PRODUCTION ON AN OHIO ROAD JOB

Work was started on May 2 and from that date for seven weeks the daily footage increased from the low of 168 ft. in the first week to 738 ft. in one day of the seventh week; from a daily average of the first week of 295 ft. to daily averages for the following weeks of 412, 439, 553, 489, 572, 659. The low days were caused mainly by insufficiency of water supply.

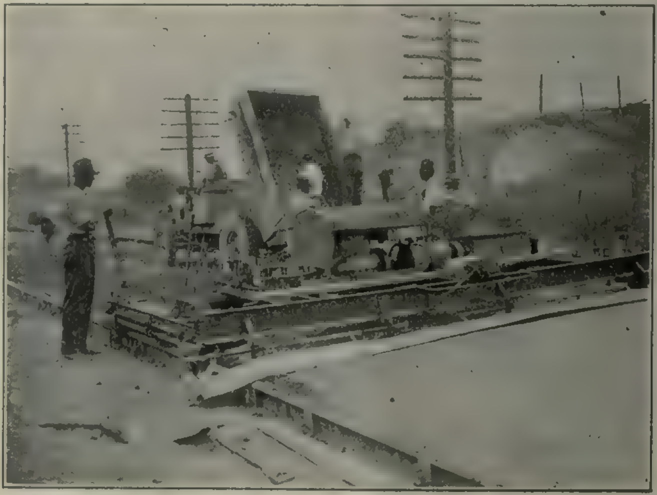
Thus it is seen from glancing at the above footages of concrete laid, that profits to the contractor are dependent upon more than the selection of good equipment. The water supply, hauling of materials and many other factors enter into the work.

The superintendent of this job was an engineer and he solved the difficulties which hindered quantity production so that in seven weeks the same plant was producing more than double the amount of pavement it had produced the first week.

Novo Engines and Equipment

A catalog describing the Novo line of gas, gasoline and kerosene engines, and air compressor, pumping, hoisting, and sawing outfits has been issued by the Novo Engine Co., Lansing, Mich. The catalog has 105 pages and contains a large number of illustrations of the various power outfits.

Novo engines are of the 4-cycle vertical type, with hit and miss governors and jump spark ignition. The cooling is effected by water boiling from a large jacket around the cylinder, utilizing the principle that the boiling of 1 gal. of water dissipates approximately ten times as much heat as does 1 gal. of water flowing through the jacket.



AUSTIN TAMPER IN OPERATION—ANOTHER FACTOR IN SAVING TIME ON THE OHIO JOB

Novo engines are mounted also as a part of the equipment of an extensive line of pumping and air compressor outfits.

Cement and Aggregate Production

Cement production in the United States during the first six months of 1921 was 92% of the quantity produced in the corresponding period in 1920 and more than 42% of the total production of 1920. Slag production in the first half of 1921 was about 50% of that in the same period in 1920. Sand and gravel production in the first half of this year amounted to about 82% of that of the first half of 1920.

Texaco Asphaltic Concrete

An illustrated booklet of 14 pages, setting forth briefly the construction of asphaltic concrete pavements, has been issued by the Texas Company, New York, N. Y. Several illustrations show roads on which Texaco asphalt was used.

Concrete Pavement Construction in Hot Weather

A 12-page booklet describing concrete construction practice in hot weather has been issued by the Portland Cement Association, Chicago, Ill. A number of illustrations show various methods used in the curing of concrete, which is especially important in the summer because of the drying effect of direct sunlight and warm winds.

New P. & H. Skimmer Boom

A circular describing the new P. & H. skimmer boom designed for attachment to the P. & H. excavator crane, has been issued by the Pawling & Harnischfeger Co., Milwaukee, Wis. By the use of this boom and scoop attachment the crane is converted into an efficient road grading machine. Operating costs of this equipment at work on a job in Milwaukee County, Wisconsin, are given in the circular.

More Cement Officials Indicted

Manufacturers of 90% of Production in Northeastern States Involved in Charges

A supplementary indictment charging 19 corporations and 44 officers of the northeastern members of the Portland Cement Association with engaging in an unlawful conspiracy to violate the Sherman Anti-trust Law was filed on Aug. 31 by the Special Federal Grand Jury in New York City.

The indictment filed on Aug. 31 was supplementary to the suit in equity filed on June 30 naming 19 firms and 4 individuals and asking for the dissolution of the Cement Manufacturers' Protective Association. The equity suits in June followed indictments returned in March charging 116 corporations and individuals with criminal violation of the Sherman Law.

The defendants in the supplementary indictment manufacture about 25,000,000 bbl. annually, or 90% of the cement made in Maine, Vermont, New Hampshire, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, Pennsylvania, Delaware, Maryland, Virginia and West Virginia.

Macon Concrete Roller Co. Reduces Rental Fees

The Macon Concrete Roller Co. has announced a reduction in rental fees for its concrete roller. The new fees are: $150 per year per roller, or $30 for the first month and $20 for each additional month, with a cash deposit of $150 and minimum charge of $50; for each additional roller, $75 per year, or $15 per month, with deposit of $75.

The former fee for the use of this finishing device was ½ ct. per square yard, with a minimum charge of $100, and on small contracts $2 per day with a minimum charge of $50.

Output of Road Machiney Greater Than all Other Construction Equipment

Of contractors' equipment manufactured in 1919, valued at $186,297,000, machinery used in road building formed the major part, with a value of $105,149,000, according to a preliminary statement of figures from the census of 1920 on manufactures, issued by the Census Department of the Department of Commerce. Concrete mixers valued at $9,579,000 were manufactured; excavating machinery at $6,641,000; pumps and equipment, $65,360,000; road machines, $13,915,000, and steam shovels, $9,654,000.

◆

The State of Maine has sold $1,750,000 of 6% road bonds to the Fidelity Trust Co., of Portland, Ore., and Brandon, Gordon & Waddell, of New York City, at 98.147.

The Last Important Toll Road in Pennsylvania, the Chester-Darby Turnpike, has been purchased by the State Highway Department. Governor Sproul spoke at the exercises when the toll gates were removed.

The City Council of Pittsburgh, Pa., will submit a $2,000,000 bond issue to the voters at the November election, to be used for the construction of a bridge to replace the Point Bridge over the Monongahela River.

A Wooden Bridge in Volusia County, Florida, collapsed on July 17 shortly after a truck passed over it. The bridge crosses Smith Creek and is the only means of egress north from Daytona Beach and Ormond Beach.

Seven Motor Ambulances and one motor bus for the insane are operated by Bellevue Hospital in New York City. Judging from the number of accidents in the metropolis due to reckless driving, it would appear that the hospital has inadequate motor equipment.

MEETINGS

Calendar of Coming Meetings

Sept. 7-9.—League of Virginia Municipalities.—Annual convention, Norfolk, Va. Secretary, L. C. Brinson, Portsmouth, Va.

Oct. 12-14.—League of Kansas Municipalities.—Annual convention, Lawrence, Kan. Secretary, John G. Stutz, University of Kansas, Lawrence, Kan.

Oct. 19-20.—North Carolina Good Roads Association.—Annual convention, Greensboro, N. C. Secretary, H. M. Berry, Chapel Hill, N. C.

Oct. 20-21.—Ohio State Conference on City Planning.—Annual conference, Columbus, O. Secretary, Charlotte Rumbold, Cleveland, O.

Oct. 24-28—American Society for Municipal Improvements—Annual Convention, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Nov. 14-16.—City Managers' Association.—Annual convention, Chicago, Ill. Secretary, H. G. Otis, City Manager, Clarksburg, W. Va.

Nov. 16-18.—National Municipal League.—Annual convention, Chicago, Ill. Secretary, H. W. Dodd, 261 Broadway, New York, N. Y.

PERSONAL MENTION

Hirst Will Stick to Job

Sometime ago A. R. Hirst, State Highway Engineer of Wisconsin, tendered his resignation effective not later than the end of this year. However, he has decided not to quit, according to W. O. Hotchkiss, Secretary of the Commission, who recently stated that, "In spite of adverse conditions the State Highway Commission is glad to announce Mr. Hirst has yielded to our urgent request and will remain with us."

A. B. Edwards has been appointed city manager of St. Albans, Vt.

Frederick A. Synder has been appointed resident engineer by the New York-New Jersey Tunnel Commission.

Samuel D. Foster has been appointed consulting engineer for the Allegheny County, Pennsylvania, Planning Commission. Mr. Foster, was at one time chief engineer of the Pennsylvania State Highway Department.

Awarding Highway Contracts in the Fall

(Concluded from page 126)

storage of materials, warranted by the definite plans made for construction. Just as the overhead costs of road building are reduced by the interseasonal work so is the overhead cost of material production reduced. This reduction reflects in the cost of finished roads.

(c) More Efficient Organizations The effect anticipated by enabling construction companies to carry on interseasonal work is a general reaction towards efficiency. By utilizing as many men as possible on various kinds of preliminary work, a well trained nucleus can be retained and this nucleus can then be expanded into an efficient organization when operations open in full.

In addition to the better results obtained by a competent crew of mechanics, better opportunity is afforded to investigate the source of materials and plan the work. Thus much of the late start which has compelled them frequently to purchase materials hastily or begin work before their full need for equipment had been supplied would no longer be necessary. In other words the efficiency of road building might be made to approximate the efficiency of other well-planned and well-managed manufacturing, unencumbered by the extreme fluctuation of construction.

In conclusion, the memorandum refers to the possible influence of the material market upon road building costs. It points out that this is a matter of public policy and one that will come up in connection with the plan of fall lettings.

There are two views of the present situation, according to the memorandum. One is that the awarding of all contracts should be delayed until the market becomes stable, following war conditions. The other is that "we are faced in the near future with a rising market." These must be given consideration.

It is also pointed out that the matter of fall letting is open to question on the score of the condition of the market at that season. It has sometimes been assumed that material prices are high in the fall and that, consequently, the most favorable bids can not be obtained at that time. This assumption, however, is not borne out by the records, according to the memorandum.

Another point made by the committee is that contracts that permit payment by the state for materials delivered on the job allow the contractor to gather his materials in the winter season and to "shop" for the best prices. "The fall letting," according to the memorandum, also "permits the highway commissions to keep skilled and satisfactory contractors in the service of the state and permits the highway commissions to maintain a level organization and staff for the administration of such contracts."

District Road Engineers of Maryland have been made deputy state foresters. By this arrangement it is hoped to hasten the beautification of the roads in the state.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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*Illustrated

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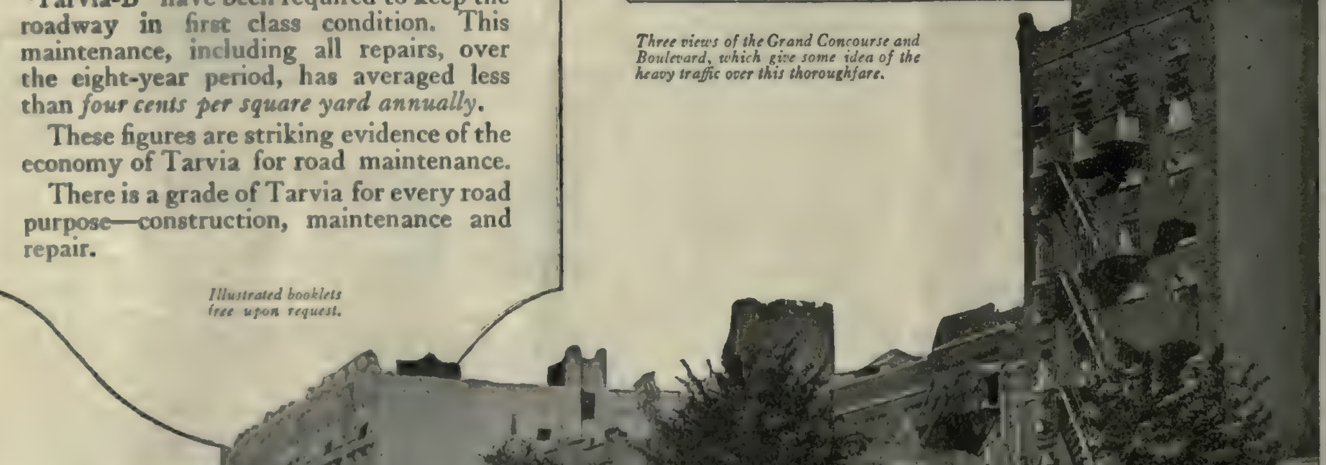

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GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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THE HIGHWAY CONTRACTOR AND ROAD BUILDER

Vol. LXI. NEW YORK, N. Y., SEPTEMBER 14, 1921 Number 11

Highway Research*

Suggested Methods of Study to Determine the Data Required to Put Highway and Highway Transport Engineering Practice up on a Scientific Basis

By W. K. HATT†

For the purpose of a coordinated and comprehensive program of highway research, the writer has been endeavoring to bring into the picture all the elements in the situation in highway transport; engineering, including vehicle and road; economics of transportation; administration; and finance. Some comprehensive and logical assemblage will be helpful.

It appears that there are many dimly seen figures which should be advanced from the background; there is much that is unknown. We may ask a few questions which cannot be completely answered.

HIGHWAY RESEARCH IS DEMANDING AND RECEIVING MORE AND MORE ATTENTION from road builders and those who,though not themselves builders of roads, are interesting themselves in road builders' problems. One manifestation of this growing interest in a subject of the utmost importance to every man, woman and child in the nation is the establishment of the Highway Research Committee of the National Research Council. In this article, Professor Hatt, recently appointed director of that committee, outlines the study to be undertaken.

Some Fundamental Questions in Highway Transport

The Transport Unit

(1) What is the economical highway truck unit for each of the several situations, e.g., intercity, farm to market? What is the cost of transport arising from vehicle and from road?

(2) What is the relation of this economical unit to other systems of transport, e.g., electric and steam, in a unified system?

(3) To what extent, as a matter of public policy, should any transport unit be indirectly subsidized?

(4) What traffic regulations should be imposed upon such economical unit over other types of road? What fees should be charged for service rendered to vehicle by the road?

(5) What should be the proportion of the total traffic supplied by such economical unit to justify a special design of road for such unit?

(6) What prediction can be made of future changes in general traffic, and what is the influence of these upon the economics of the present situation?

(7) How should passenger traffic over the highway be evaluated?

The Road

(1) What type of road paving should be selected for a specified transport unit?

(2) If the road cannot be economically fitted to the truck transport unit, can the latter be modified in design to fit the road?

(3) How should the design of the road and paving be modified to meet changing conditions of subgrade, climate, etc.? How shall subsoils be improved?

(4) What sum of money is the locating engineer justified in spending to avoid increase in distance, curvature, rise and fall, maximum grade, maximum curve?

(5) What system of maintenance and organization is best fitted for types of roads differing in traffic, in materials, and in climate?

(6) What is capacity of a road of given width for type of vehicle as expressed in vehicles per hour, ton-miles per year, etc.? What is the appropriate unit for expressing traffic for various purposes?

(7) (In construction many questions arise in selection, production and economical use of materials, standardization and regulation.)

(8) How may the volumetric changes in roads be overcome?

(9) What is the economical life of various types of roads; that is, when maintenance charges exceed earning value?

Administration

(1) What should be the policy in control of truck and bus transportation systems, terminals, routing, etc.?

(2) What police regulations should control use of roads?

(3) What is the best administrative and executive organization for administration and operation of roads?

---

*Paper presented at the Conference on Highway and Highway Transport Economics held by the Highway and Highway Transport Education Committee of the U. S. Bureau of Education at the University of Maryland, July 27, 1921.

†Director, Highway Research Committee, Division of Engineering, National Research Council.

(4) What principles should govern the selection of a system of roads in its various parts, as influenced by interstate, intra-state, county, local traffic, etc.?

Financing

(1) What should be method of financing construction and maintenance of roads? What portion of cost from long-term bonds, and what from current funds? What form of bonds should be issued and how create a market for them?

(2) What should be relation between life of bonds and economical life of road?

(3) To what extent do social betterment, military use, i.e., social value, and other imponderables enter into highway policy?

(4) What should be the distribution of costs as between federal, state, county, township, property benefitted, the user and other units?

(5) How shall the future maintenance charges on completed road systems be met? Shall the user pay all of these?

(6) How shall safety be insured on the roads?

(Concluded on page 140)

Tentative Chart
To Show Origin of Flow of Data from
THE FIELD OF HIGHWAY RESEARCH
Important Elements Demanding Study Arising in the Divisions of I to V
(Structures Omitted) (Elements Are Often Inter-Related)
Static Chart Committees Organized to Occupy the Field

I
ECONOMIES
(Data for Economic Survey and Study of Project)

1 Traffic Studies (Regional)
- A. Distribution in region
- B. Character (traffic blank)
  - Vehicle
  - Weight and distribution
  - Speed
  - Tire (condition)
  - Commodity
  - Length haul
- C. Method of expressing unit of traffic
- D. Predicted charges
- E. Other traffic on steam and electric roads
- F. Central sources of traffic

2 Community Needs
- Systems of roads in classes for industries, etc.
- Intangibles

3 Cost of Transport
- Capital cost
  - Road
  - Vehicle
- Fixed charges
- Overhead
- Operation
  - Maintenance
  - Routine
  - Replacement on road
    - On vehicle
- Equivalent units, x-auto—y-ton truck, etc.
- Economic life

4 Economics of Location
- Cost of distance
  - Rise and fall
  - Curvature
  - Ruling grade
  - Ruling curve

5 Financing
- Bonds
- Taxes
- Fees
- Etc.

6 Highway Valuation
- Increment of land values

II
OPERATION

1 Control of Traffic
- Routing
- Terminals
- Franchises
- Police regulations

2 Accident Insurance

3 Planning Systems of Transport
- Financing
- Environment
- Relation to other transport organization

4 Financing (See I)
- Bonds, taxes, fees

5 Distribution of Costs
- Traffic
- Property
- Political units

6 Maintenance Systems

7 Maintenance Machinery

8 Maintenance Methods
- Routine
- Replacement
- Snow removal, etc.

9 Trail Marking

10 Cost Accounting

11 Safety

III
DESIGN
(ROAD)

1 Subsoil Studies
- Properties
  - Physical
  - Mechanical
  - Chemical
- Drainage
- Supporting power
- Improvement by treatment
- Effect of road deformations
- Effect of climate
- Distribution of pressure

2 Base Course
- Character, type
  - Thickness
  - Materials
  - Cross section

3 Surface
- Character
- Thickness
- Materials
- Cross section
- Wear by traffic
- Wear by elements
- Impact of traffic
- Tractive resistance
- Wear of tire
- Wear of vehicle
- Dusting.
- Influence of locality

4 Cross Section
- Width
- Crown
- Shoulders
- Ditches

5 Loads
- Static
- Impact
- Surface integral as effected by design of vehicle

6 Design of Integral Slab
- Strength and stiffness of
  - Solid
  - Precast
  - Cellular

7 Volume Changes
- Joints
- Shoving

8 Reinforcing
- Theory of
- Amount
- Kind
- Distribution
- Direction

IV
DESIGN
(VEHICLES)
As Related to Road

1 Design of Vehicle
- Power gear ratio
- Braking
- Etc.
- Etc.
- Effect on loads
  - Sprung
  - Unsprung
  - Distribution

2 Economy of operation and maintenance
- (See Automotive Industry)
  - Economic limit of size of truck in various situations
  - Cost of truck transport (Schedule of Elements)
  - Economic limit of haul
  - Cost accounting

3 Surface
- Tractive effort
- Wear on tires
- Loads
- Maintenance of vehicle

4 Alignment
- Curves (speed)
- Grades

5 Cross Section
- Width
- Crown

6 Safety

V
CONSTRUCTION

1 Materials
- Bituminous
- Non bituminous
- Fundamental mechanical properties
- Methods of test
- Standard tests
- Specification
- Preparation and treatment (See Special List)
- Proportioning

2 Mixing
- Efficiency of mixer
- Central mixing plants

3 Placing

4 Methods of Testing Roads
- Instrument
- Cores

5 Design of Experimental Roads

6 Drainage (and drainage structures)

7 Impact on Bridges (See Design)

8 Reinforcing, Handling and Placing

9 Inspection

10 Plant Design and Control

11 Cost Accounting

12 Construction Contracts

Time of Set of Concrete—II*

Description of Method Applicable to Neat Cement, Mortar and Concrete—Effects of Consistency, Richness and Temperature on Time of Set—Effect of Character of Cement—Proposed Early Compression Test

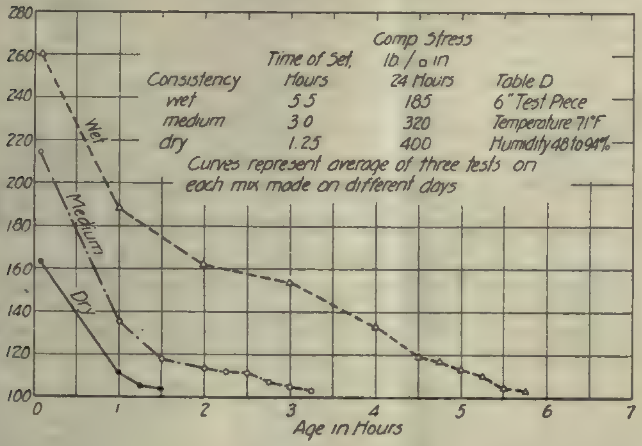
By WATSON DAVIS†

(Concluded from Sept. 7)

Discussion of Tests

Effect of Consistency on Set. That the wetter the consistency the slower will be the set seems to be a general law, so long as cement, mix, and aggregate are the same. In every case in the data obtained an increase in initial flowability of a given mix is accompanied by an increase in the time of set. Except for the influence of the setting quality of the cement itself, excess water producing wetter concrete is the most important factor influencing the time of setting of concrete. The retardation of set is most marked in the leaner mixes.

Fig. 4 shows the influence of wetness or consistency on the rate of setting of 1:1½:3 concrete. This diagram presents average curves of tests made on three consecutive days. Data on 24-hour strengths are also included.



Consistency	Time of Set, Hours	Comp Stress lb/□ in 24 Hours	Table D
wet	5.5	185	6" Test Piece
medium	3.0	320	Temperature 71°F
dry	1.25	400	Humidity 48 to 94%

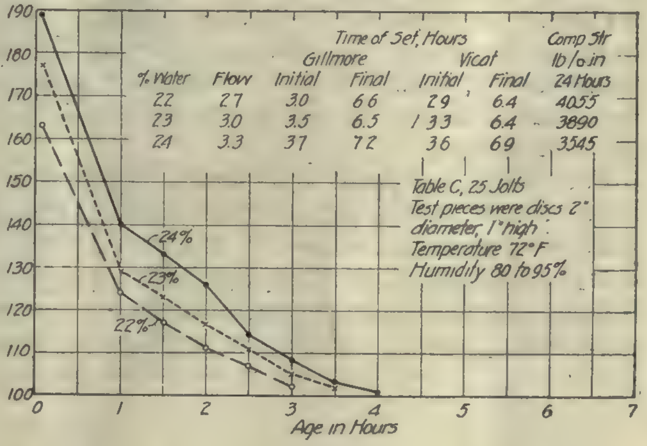
Curves represent average of three tests on each mix made on different days

FIG. 4

The effects of different percentages of water on the setting of a neat cement are shown in Fig. 5, which gives average curves of tests, repeated three times, of the time of set of neat cement when gaged with 22, 23, and 24% of water. Data on 24-hour strengths are also presented.

These results indicate that for each per cent. increase in the gaging water the time of set is lengthened on the average about 20 minutes. Time-of-set tests on neat cement using 25 and 30% of water also confirm this conclusion.

Effect of Richness on Set. A rich concrete will set faster than a lean concrete, provided the two concretes are of the same consistency or initial flowability and are made of the same materials. In Fig. 6 are plotted time-of-set tests on neat cement, 1:1½:3 concrete, and 1:3:6 concrete of approximately the same relatively wet consistency. These curves are the average of four tests of each mix on different days, and show the variation in set with richness for the consistency given. Other tests not reported show that the effect of richness on set is minimized when the consistency is so dry that only a small decrease in flowability is necessary to cause the concrete to reach the point of no flow or to become set.



% Water	Flow	Time of Set, Hours Gillmore Initial	Final	Vicat Initial	Final	Comp Str lb/□ in 24 Hours
22	2.7	3.0	6.6	2.9	6.4	4055
23	3.0	3.5	6.5	3.3	6.4	3890
24	3.3	3.7	7.2	3.6	6.9	3545

Table C, 25 Jolts
Test pieces were discs 2" diameter, 1" high
Temperature 72°F
Humidity 80 to 95%

FIG. 5

Effect of Character of Cement on Set. The character of the cement is undoubtedly the most important factor that influences the setting time of concrete. Variations of gypsum content, method of manufacture, raw materials and fineness all affect the setting properties of the cement and these properties of the cement are reflected in the concrete in which the cement is used. In view of the fact that it is generally recognized that cements of different character may have widely different setting times, the tests reported in Figs. 7 and 8 were not carried to the point where they would be rigorously conclusive, and represent results of single tests only.

Cement U is a natural cement that is fairly quick setting. Cement L is a Portland cement that has normal setting properties, while cement S is a Portland cement that is abnormally slow setting. Setting tests of these three cements in a neat mix are shown in Fig. 7. The percentages of water determined by the routine specification test for "normal consistency" made by the Vicat needle were used and this accounts for the discrepancy in the initial flow shown by cement L.

---

*Paper presented at the 24th annual meeting of the American Society for Testing Materials, Asbury Park, N. J., June 21-24, 1921.

†Assistant Engineer Physicist, Bureau of Standards, U. S. Department of Commerce.

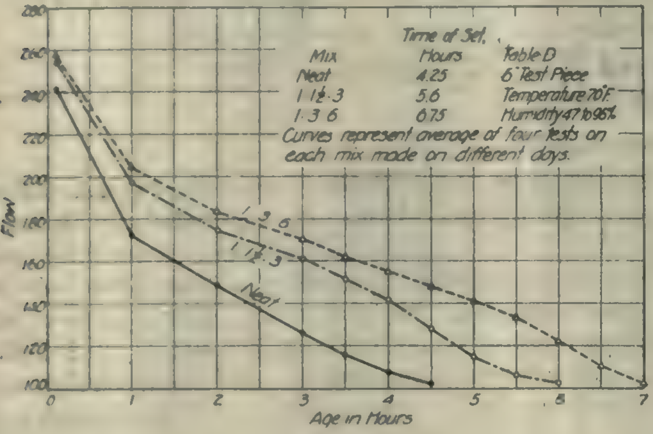


FIG. 6

Fig. 8 shows the result of using these cements in 1:2½:3½ concrete.

While the setting properties of the cement determine in a large measure the setting properties of the concrete, in general, the differences between the setting times of concretes have a tendency to be less than those between the setting times of corresponding neat cements.

For the tests reported in all figures except Figs. 7 and 8, normal setting cements were used. Although different cements were used in the tests of Figs. 9 and 10, the range of setting times determined by the Gillmore needles on neat cements of routine "normal consistency" was only from 4.5 hours to 5.9 hours for initial set and from 7.5 hours to 8.4 hours for final set. Cement used in tests Figs. 4 and 6 had setting times of 3.7 hours and 7.1 hours for initial and final sets, respectively, by the Gillmore needles.

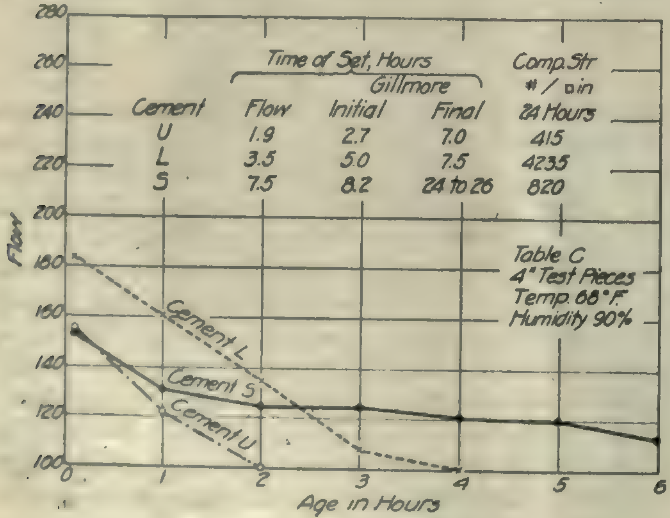


FIG. 7

Relation of Time of Set of Neat Cement and Concrete. As pointed out above, neat cement sets faster than the concrete made from it. Conditions of temperature, aggregate, cement content and consistency materially affect the setting time of concrete, and while the setting properties of the cement as determined by a needle test on a neat mix of normal consistency are reflected in the concrete, they are changed and influenced by the conditions peculiar to the concrete. For these reasons it is believed that to determine the setting properties of concrete, tests must be made on the concretes themselves.

Effect of Calcium Chloride on Set. The data in Fig. 9 show the effect of gaging, 1:2:4 concrete with solutions of calcium chloride. Two calcium-chloride solutions were used. One referred to as "compound X" is sold under a trade name and is approximately a 30% solution of calcium chloride. The second solution was made from commercial calcium chloride. Both solutions, before using in the mixes, were diluted to contain 4% of calcium chloride. The same cement, aggregates, proportions and consistencies were used in all mixes compared, and the calcium chloride was the only variable introduced. In all cases the 4% calcium chloride solution caused the set to take place in about half the time required by corresponding mixes gaged with plain water. The two calcium chloride solutions from different sources, but of the same concentration, had practically the same effect on set.

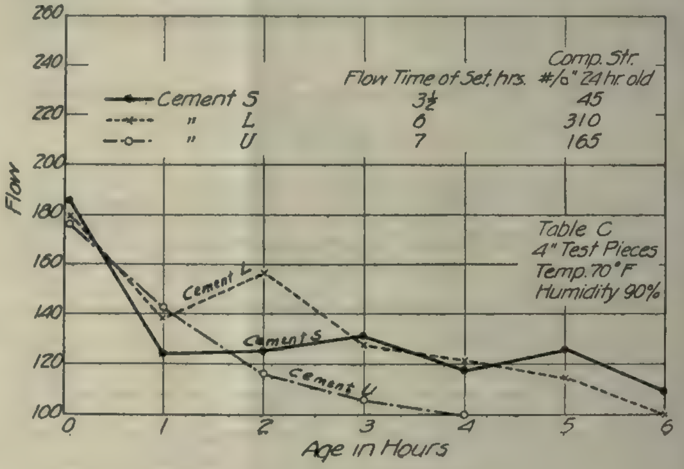


FIG. 8

Effect of Temperature on Set. The variations in time of set caused by differences in temperature are shown graphically in Fig. 10. All tests specimens were molded from one batch of 1:2½:3½ concrete under normal temperature conditions and then subjected to the temperatures and conditions stated in the figure. Both the high and low temperatures are met with in practice. The "low" temperature was just above freezing, while "high" temperature corresponds to that sometimes experienced in midsummer. Concrete at "low" temperature took over 2.5 times as long to set as that at high temperature, and the concrete of normal temperature set 4 hours before the cold concrete, and 1½ hours after the "high" temperature concrete.

Strength tests on 3x6-in. cylinders kept 24 hours under the different temperature conditions were made and the average of three tests at 24 hours under each condition showed that at high temperature the strength was 2.5 times normal temperature strength and at low temperature the strength was one-sixth that at normal temperature.

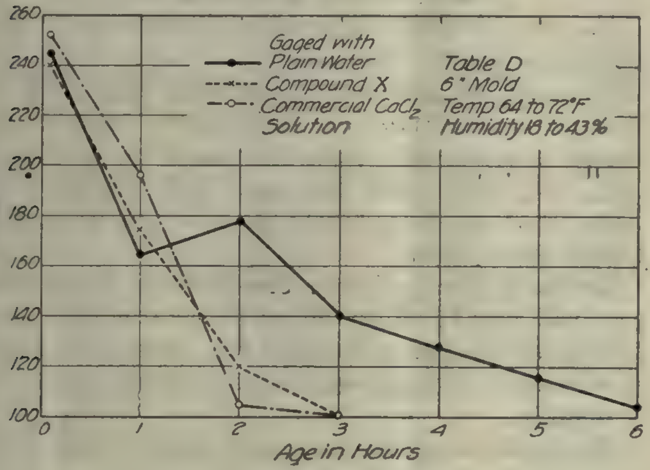


FIG. 9

While it is possible that concretes made of cements of different composition and manufacture would not always exhibit these large differences in set and strength due to temperature, undoubtedly the results presented are indications of what may be expected. In general the lower the temperature the slower a given concrete will set, and the higher the temperature, the faster it will set.

Method of Measuring Set of Neat Cement. In the tests of Figs. 5 and 7, time of set of neat cement by both the needle and flow table method was obtained. The results indicate that the flow method gives times of set that are somewhat earlier than those for initial set given by the Gillmore needle. Tests reported in Fig. 5 indicate that time of initial set by the Vicat needle is about the same or slightly earlier than the initial set by the Gillmore needle.

The flow method of measuring time of set is fundamentally different from the Gillmore and Vicat methods. In the Gillmore test only a portion of the outer surface of the pat is tested. The Vicat test depends upon the penetration of a needle into a relatively small portion of the pat. When the flow time-of-set piece is jolted on the flow table, the entire mass is affected.

The flow method could be used for routine setting tests of cement. Two set test pieces could be made of normal consistency paste and one tested at 1 hour and the other at 7 hours. Provisions could be made that a flow of 105 should not be reached when 1 hour old but that it should be reached by the end of 7 hours.

Incidentally it is believed that the flow table is a better apparatus for use in determining "normal consistency" of neat cement than the Vicat apparatus.

Nature of the Flow Changes Occuring during Setting. The rate of the changes in flowability that takes place during the setting seems to be influenced by the consistency and cement content of the mix. When the mix is of small initial flowability or is rich in cement content, a large part of the flow (50 to 75%) is lost in the first hour after mixing. When the mix is of wet consistency and has a small cement content, the decrease in the first hour after mixing is smaller on a percentage basis, but during this first hour the rate of decrease is usually higher than during any other period. A probable explanation of these initial decreases is that they are caused by a combination of setting and absorption. The cement and aggregate gradually absorb water during this period, thereby doing their share in decreasing the flowability.

Tests not reported show comparatively rapid decrease in flowability determined at short intervals (3, 5 and 10 minutes) after mixing, showing that there is a stiffening of the mix due to absorption in the first few minutes during and after mixing.

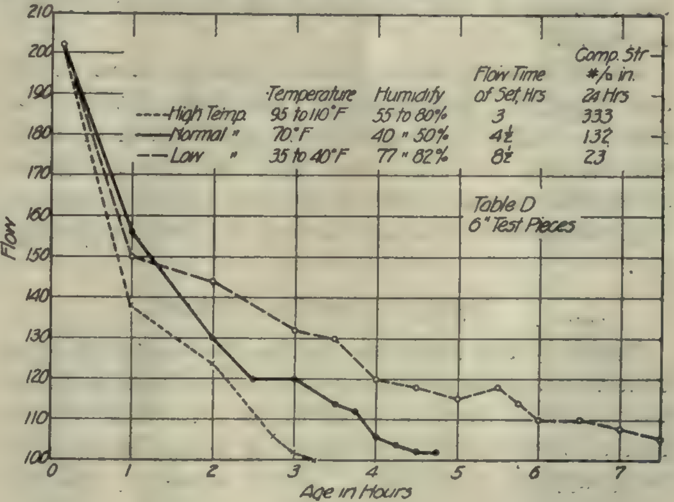


FIG. 10

While this absorption of water is comparatively more rapid in the first 10 minutes during and shortly after the mixing, the absorption is probably not completed then. Although diminished, it probably continues through the first hour or more after mixing, and combined with a true setting action, causes the initial decrease referred to above.

It was thought that the relatively large decrease in flowability noted above might be due to an actual loss in water by evaporation or other cause. Weighings of several test specimens of the various series were therefore made to determine this possible loss. While specimens stored in air at low humidity showed losses of water, those stored in the moist cabinet at high humidity did not. As initial losses in flowability are noted in both cases it is concluded that loss of water is but a minor contributory cause. It was noted that a considerable loss was due to leakage of water from the test specimen in the case of the wetter mixes, and not to evaporation.

Early Strength as a Measure of "Final Set." That flow time of set corresponds approximately to the initial times of set by the needle methods when used for neat cement has been shown in data presented above. But the final set tests by the needle methods can be applied only to neat cements, and even then are of no real use and require much time to complete. The test needed is one that will tell the condition of the concrete at an early age and give definite information that can be used in deciding when to pull forms, or to perform some other operation. A compressive strength test at an early age, say 24 hours, will give such information. A test of this kind is suggested as a substitute for tests of final set.

Twenty-four hour compressive strengths are reported in Figs. 4, 5, 7, 8 and 10. Early strengths necessary for different purposes could be determined and specified. Some cases where such a test would be important are to determine time for removal of forms, ability to carry the dead load of structure, and the opening of concrete-paved sidewalks and streets to traffic.

There is no general relation between time of set and strength. Reference to Figs. 7 and 8 will show that the fastest setting mixes are the weakest while the slowest setting ones have the next highest strengths. In the case of calcium chloride accelerated mixes those that set fastest are also the strongest.

Uses of Flow-Set Method

Probably the chief use of this method of making time-of-set determinations of concrete will be in investigational work in concrete to determine the effect of various factors on set. It is also capable of being applied practically. This is shown by the following example:

A floor was being laid, and a 1:2 mortar topping accelerated by using a calcium-chloride solution for gaging liquid was used for one portion, while the rest was laid with mortar gaged with plain water. Flow set determinations were made and the opinion of the finishers was obtained. This test brought out the fact that a mortar of a flow of about 190 could be wood-floated, while when it had a flow of about 140 it was in about the right condition to finish with a steel trowel. Once these flow constants were determined for the table and mold used, preliminary tests could determine very closely the time at which floating and finishing could be begun.

There is a certain minimum of consistency or flowability of concrete that can be used for certain purposes, such as in a reinforced concrete building, and the length of time that the concrete retains a flowability greater than the minimum can be determined by the flow method.

Undoubtedly this method of measuring time of set can be applied to measuring the rate of stiffening of limes, plasters, clays, etc., and other plastic materials.

Other Factors Affecting Set

Factors other than those that have been investigated undoubtedly affect the time of set.

The kind of aggregate, depending largely on its absorptive properties, will probably be found to influence the setting. Concretes made of absorptive clay, slag, and stone aggregate will probably set faster than similar concrete made of non-absorptive quartz aggregates.

Similarly, the moisture condition of the aggregate will tend to affect the set of the concrete. Wet aggregate will probably make the setting relatively slower, while dry aggregate will probably accelerate it slightly.

The gradation of the aggregate, the fineness of the sand and the relative amount of coarse aggregates may have some effect on set, and this is a field for future study. The change in setting time caused by the addition of different salts, admixtures and proprietary compounds may be determined by the method described.

It is believed that humidity has little effect on set, although no correlated data are presented on this factor. It should be noted that the whole test specimen is used in the flow-set test, and that for that reason, surface drying caused by low humidity probably does not materially affect the result. Humidity probably does affect the results of the Gillmore and Vicat methods of determining the time of set of neat cement as these tests are made on the surface rather than the body of the test specimen.

Acknowledgment. It is desired to acknowledge the aid of Mr. G. M. Williams' preliminary work in developing the flow table which was the necessary antecedent of this work, and to give credit to Mr. R. A. Sherman for careful assistance in the carrying out of the tests.

◆

Mercer County, Pennsylvania, will vote on a $1,400,000 road bond issue in November.

Gasoline Tractors are manufactured by 90 firms in the United States, according to a recent statement.

Some 80% of the Automobiles Stolen in Chicago, Ill., are disposed of with the knowledge and consent of their owners, according to the Motor Squad of the Police Department of that city.

GOOD ROADS
CONSTRUCTION TRANSPORTATION MAINTENANCE

Founded January, 1892

E. L. POWERS
Editor

T. A. HULBERT
Managing Editor

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Copy for classified and other advertisements where proofs are not required will be accepted until noon on Monday of the week of issue.

Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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Vol. LXI. September 14, 1921 No. 11

AUTOMATIC TRAFFIC COUNTS

Although in the past traffic counts in this country have been sporadic and spasmodic for the most part, road builders are fast realizing the importance of systematic and correlated traffic records. Highways are built solely for carrying traffic and it naturally follows that the more the road builder knows about the type and quantity of traffic the roads must bear, the better able will he be to cope with the engineering and economic problems confronting him. Especially important are traffic data in their relation to economic problems, as justifiable costs of pavements and distribution of construction and maintenance funds.

Traffic counts as now taken generally yield incomplete data and involve considerable expense. Observers are stationed at given points, who enumerate and roughly classify the vehicles passing. This method at its best can give but incomplete information.

At a recent road convention, A. B. Fletcher, Chief Engineer of the California State Highway Department, stated, "I think it is possible to devise an automatic weighing and counting device; and I believe it possible in that way to obtain a real traffic census. I see no other real solution."

In this age of labor saving devices, it seems strange that an instrument has not yet been made which will count and weigh vehicles passing over a road. At first sight it might appear that such a device would be too difficult and too costly to construct, yet it must be remembered that the industries are using successfully automatic weighing and counting machines. Surely, with the great saving in wages of observers and the continuous and accurate traffic data obtained, the use of such a device would not be costly.

Accordingly, it behooves our manufacturers of road equipment to study this matter, both as a possible opportunity for profit and as a means of advancing road building.

Weak Links in the Road Chain States spend hundreds of thousands of dollars for the improvement of through routes. Most of these routes pass through cities and villages and not infrequently the portions within their limits are the worst sections. There ought to be some way by which a state could compel such municipalities to keep in condition those streets that lie on state trunk lines.

Automobile Accidents Labor Day brought the usual holiday or week-end crop of automobile accidents, nearly all of them avoidable. The remedy for these results of unskillful or reckless driving is obvious: First, enforcement of the generally adequate existing laws, and second, the enactment and subsequent enforcement of any needed additional ones.

Progress in British Road Building The Ministry of Transport of Great Britain has instructed the division engineers in its Roads Department to superelevate curves. These instructions have been issued after mature consideration and investigation, the latter bringing to light the fact that this method "has already been recognized and adopted by French Engineers and by road authorities and engineers in the United States." It does not appear from the information in hand that the investigators unearthed the fact that the superelevation of curves has been standard practice in the United States for several years.

The Railroads and Motor Transport The railroads, both in this country and in Great Britian, are beginning to realize the possibilities in the development of motor transportation and some of them profess to see a menace to their own business in the increasing use of motor trucks and passenger cars for the performance of a service of which they apparently felt they had a practical monopoly. One American railway system has gone into court to oppose the operation of competing motor transport lines and another has reduced its freight rates on short-haul business in an effort to meet the new competition, while some of the English railroads have asked authority to utilize motor transport as an auxiliary to their regular service.

Highway Research

(Concluded from page 134)

Answers to these questions cannot be made without data that are at present unavailable.

Research is necessary, and a mobilization of the efforts of research agencies in a comprehensive program. The Highway Research Committee of the Division of Engineering of the National Research Council has undertaken the coordination of such research. The National Research Council will not engage in research directly.

The chart reproduced herewith (see page 134) is devised to indicate the field of research as divided into sub-fields in which research should be developed, and from which data should come to enable answers to be made to these questions, among others.

Some of the studies that should be made are as follows:

(1) To develop a traffic census blank. Here a traffic classification must be made, the purpose of the census determined, and the various forms and instructions standardized.

(2) In order to determine the cost of transport a statistical table must be made that notes all of the elements of cost; sometimes only a few of these are reported.

(3) To study the operating costs of elements entering into location of highways, such as distance, grade curvature.

(4) To study loads on roads as produced by the vehicle.

(5) To study design of vehicles with a view to lessening their effects on the road.

(6) To study supporting power and improvement of subgrades and the relations to design of paving.

(7) To study resistance of concrete slabs to alternate stresses and to surface loads.

(8) To study proportioning and use of bituminous materials.

(9) To study bonding of brick surfaces.

(10) To study volume changes and the means of meeting them.

(11) To study operations of concrete mixers.

(12) To study the organization and economics of construction plants.

(13) To study sand-clay, top-soil, and gravel roads.

(14) To study cellular and other new types of paving.

There is apparently a widespread activity in highway research throughout the United States on the part of the Bureau of Public Roads, the U. S. Army, the state highway commissions, the universities, and of industrial organizations; and an earnest desire to put highway construction on a scientific basis.

The economic features are under critical examination by such organizations as the National Chamber of Commerce.

We should be able to express quantitatively the results of a standardized economic survey of a road project, just as in the case of a water power project, for instance, except for those imponderables which, like social betterment and public policy, influence the conclusions so profoundly.

It is not too much to say that the situation is critical, and that the sooner those interested come to a basis of fact, the more assurance we will have that the public will not interrupt progress in providing for highway transport because of a general feeling of insecurity.

Tennessee Freight Rates on Road Materials Increased

The Interstate Commerce Commission has ordered all railroads in Tennessee to increase rates on road materials in carloads consigned to public works to correspond with the 25% increase in freight rates recently ordered by the commission. Road materials had been carried at the old rates by order of the State Public Utilities Commission.

Railroads of Virginia Reduce Rates on Road Building Materials

In order to stimulate road construction during the remainder of the year the railroads of the state have agreed to reduce freight rates on road materials 25% until the end of 1921. This reduction of intra-state rates is extended to materials used in the construction of houses, it being hoped to stimulate road construction and home building and at the same time relieve unemployment in the state.

Examination for Highway Economist

Applications will be received until Dec. 1 by the U. S. Civil Service Commission, Washington, D. C., for the positions of highway economist and assistant highway economist. Applicants must be college graduates with at least two years of undergraduate work in economics or commerce. The pay for highway economist is $2,400 to $3,600 per year and for assistant, $1,500 to $2,400 per year. Applicants will not be required to report for examination at any place and papers will be rated as received.

◆

The State of Ohio has 677,000 motor vehicles registered.

Horses in Philadelphia, Pa., now number but a third of those in use before the days of the automobile.

The State of Wisconsin is laying about 12 mi. of concrete road a week. Between 30 and 40 mi. of other types of roads are also being built each week.

In Algeria 11,000 Automobiles are in use between coast cities and between mountain and desert settlements, comparing favorably with train service as to time and cost.

"The Highwayman"

The New Jersey State Highway Department has commenced issuing a monthly publication with the above title. The publication will furnish information to the public on road work in the state.

Good Roads Essay Board Appointed

The committee to judge the essays on "Good Roads and Highway Transport" submitted in the Firestone university scholarship contest has been appointed as follows: A. N. Johnson, Dean of the Engineering School, University of Maryland, Chairman; Harford Powel, Jr., Editor, "Collier's Weekly," and C. H. Huston, Assistant Secretary, U. S. Department of Commerce. The contest is conducted under the auspices of the Highway and Highway Transport Education Committee of the U. S. Bureau of Education.

Bomb Proof Culverts

A new use has been found for the corrugated-metal shelters originally designed for use in France for bomb proof dugouts. At the close of the war the Government found itself with several tons of this material on hand.

A large amount of it has been secured by the Arizona State Highway Department with the idea of bolting the sections together in such a way as to form very large and heavy culverts, the diameter being 9 ft. 6 in.

It is planned to use some of these culverts as cattle passes on the Nogales-Fairbanks Highway, as they are far cheaper than concrete. One will also be used in Lonesome Valley on the Prescott-Jerome Highway where a 6-ft. concrete pipe was recently washed out.

Senate May Investigate Federal Road Expenditures

Shortly before the close of the extra session of Congress Senator King introduced a resolution calling for an investigation of the expenditures of federal aid funds. Three engineers, two from the Army, are to be appointed by the President, with an appropriation of $50,000 to defray the expenses of the commission.

Last February, while the Senate Committee on Post Offices and Post Roads was killing federal aid appropriations, Senator King announced that he would introduce a resolution for an investigation of federal aid expenditures. The Senator from Utah has now come to the front with his long delayed resolution, declaring that reports are in circulation that federal funds have been spent "in an extravagant and wasteful manner and that the road construction actually accomplished has not been commensurate with the labor and moneys expended."

Bridge Work in South Carolina

Five Structures Costing $2,000,000 Will be Erected by State Highway Department

The bridge program for this year of the South Carolina State Highway Department involves the construction of five large bridges over the Santee, Wateree, Pee Dee and Savannah Rivers, the latter river to be bridged at two points.

Work has been started on the Santee River Bridge, between Berkley and Williamsburg Counties. This structure will cost $850,000.

The Waterlee River Bridge, between Sumter and Richland Counties, is now under construction, and will cost about $250,000 to complete.

Concreting has been started on the Sand Bar Ferry Bridge over the Savannah River, between Aiken County and Augusta, Ga. The estimated cost of this bridge is $260,000.

The site for the Savannah River Bridge near the City of Savannah has been selected and the bridge will be built when its financing is arranged.

A bridge over the Pee Dee River, near Mars Bluff, will be erected at a cost of about $350,000.

New Forest Road Completed in Utah

About 20 Miles of Important Highway in the Fillmore National Forest Built by the Forest Service and the Bureau of Public Roads

A forest road project in the Fillmore National Forest in Utah has been completed recently by the Forest Service and the Bureau of Public Roads of the U. S. Department of Agriculture.

The road connects Sevier with Cove Fort, and is approximately 20 mi. long. The work was executed by two contractors. One built the section beginning at Sevier and ending approximately .75 mi. east of the summit of the Pataunt Mountain Range. Its length is about 14 mi. and the cost of the work was $38,639.40. The remainder of the road, 6.44 mi. long, across the mountain, was built by the other contractor at a cost of $21,439.61.

The road is a single track road, with a grade of about 7%. There were 7,273 cu. yd. of rock excavation and 35,902 cu. yd. of common excavation.

The cost of the road was borne by the Forest Service and the State of Utah, the former contributing $40,345 from its road appropriation.

According to Acting Chief Engineer Lantz of the Forest Service, the road is an important connection between two main north and south state highways and is of considerable importance to mining operations in the Fillmore National Forest and to grazing permittees. It will also facilitate the administration, development and protection of the forest. In addition, it will aid lumbering operations in the vicinity, as adjacent on the north there are approximately 2,000,000 ft. of saw timber, as well as cord wood and poles.

EQUIPMENT--TRADE--MATERIALS

Austin Distributes Paper Weights

AUSTIN PAPER WEIGHT

The Austin Machinery Corporation, of Chicago Ill., is sending to prospective customers a novel paper weight of glass to represent its "cube" mixing chamber. The glass cube contains red sand and a brown bean, and by adding white sand which is sent along with the paper weight, the action of the "cube" concrete mixer is illustrated by revolving the paper weight, the red and white sand being rendered into a homogeneous mixture. The brown bean demonstrates the folding action, the bean coming up through the mixture three times with each turn of the cube.

Salvaging a Concrete Pavement

Method and Cost of Resurfacing Improperly Constructed Cement Concrete Pavement With Bituminous Concrete

By F. W. ULLIUS, Jr. *

A cement concrete pavement was laid on Beverly Road, Shorewood, Wis., in 1912. The work was done by contractors without experience in concrete pavement construction, and no specifications were furnished them. The result was a pavement laid as a concrete sidewalk would be built. There was a base course of fairly rich concrete, covered with a wearing course of 1¼ in. of grout.

By the following spring the pavement had begun to fail. The top had come off in many places and it seemed that the work would have to be done over. However, it was not until the spring of 1919 that repairs were ordered, and by that time more of the top had separated from the base, the total amount that had worked loose being about 25%.

Several methods of resurfacing were suggested, the one finally adopted being the laying of a wearing course of bituminous concrete. One of the determining factors in the decision was the necessity of keeping down the thickness of the resurfacing in order to prevent too great a reduction of the height of the curb and the raising of manholes and catch basins.

The broken and cracked portions of the pavement surfacing were removed, leaving only sound concrete for the base. The pavement was then swept clean and covered with a mixture of 3 parts of crushed limestone and 1 part of sand, with 16 gal. of Tarvia KP to the cubic yard of aggregate. The pavement was then rolled with a 5-ton roller and allowed to cure for 10 days.

On account of the lateness of the season, it was thought best to defer further work until spring, so a thin coat of sand was applied and the street opened to traffic.

The following spring the pavement was thoroughly swept and then given a priming coat of light tar at a rate of about 1/5 gal. per square yard of surface. The tar was applied by a tank wagon and spread with push brooms. Two days later hot refined tar was applied at a rate of from ⅓ to ½ gal. per square yard and the surface covered with pea gravel at a rate of 1 cu. yd. of gravel to 60 sq. yd. of surface. The cost per square yard was as follows:

Base:		
Preparing subgrade	$0.072	
Mixing and placing base materials	0.295	
Sand @ $1.85 per ton	0.059	
Crushed stone	0.213	
Tarvia KP @ 20 ct. per gallon	0.166	
		$0.805
Top:		
Preparing grade (sweeping)	$0.004	
Spreading Tarvia B	0.007	
Spreading gravel	0.015	
Spreading B @ 12.25 ct. per gallon	0.020	
Spreading A @ 12.25 ct. per gallon	0.043	
Roofing gravel @ $2.25 per ton	0.042	
		0.131
Total		$0.936

Rubber Tired Steam Shovel

A steam shovel equipped with rubber tires is now being manufactured by the Osgood Co., Marion, O. The advantages of the use of rubber tires are pointed out to be: The elimination of damage

OSGOOD SHOVEL WITH RUBBER TIRES

---

*Village Engineer, Shorewood, Wis.

to streets, ease of locomotion, and elimination of vibration as experienced with steel wheels.

The shovel is the standard Osgood 18, ¾-yd. revolving steam shovel and the tires are solid Firestone rib tread tires. These are mounted on steel rims pressed on the regular cast steel wheels, thus permitting the removal of the tires when desired. By attaching cleats to the rear wheels the machine is ready for service where it is not desirable to use the rubber tires.

Strauss Sues City of Seattle

The Strauss Bascule Bridge Co., of Chicago, Ill., has brought suit against the City of Seattle, Wash., to recover damages aggregating $353,140 for alleged infringement of Strauss patents in the construction of three bridges. The company recently won a similar suit against the City of Chicago, Ill., being awarded $349,500 damages by the U. S. Court of Appeals.

The Killifer Scarifer

A booklet describing the new Killifer scarifer is being distributed by the Good Roads Machinery Co., Kennett Square, Pa. In the Killifer scarifer the teeth are held rigidly to the frame which is lowered by means of hand wheels working in conjunction with bevel and worm gears. In operating the machine, the front end is lowered first and the rear end lowered as the teeth begin to enter the ground.

Herculese Powder Prices Reduced

The Hercules Powder Co., Wilmington, Del., on Aug. 20 reduced the price of all its dynamites 25 ct. per 100 lb.

"On the Job with Smith Paving Mixers" is the title of a catalog being distributed by the T. L. Smith Co., of Milwaukee, Wis. A number of field photographs are included in the booklet.

MEETINGS

Calendar of Coming Meetings

Sept. 12-17.—Seventh National Exposition of Chemical Industries.—Eighth Regiment Armory, New York City.

Oct. 10-12—North Carolina Good Roads Association.—Annual convention, Greensboro, N. C. Secretary, H. M. Berry, Chapel Hill, N. C.

Oct. 12-14.—League of Kansas Municipalities.—Annual convention, Lawrence, Kan. Secretary, John G. Stutz, University of Kansas, Lawrence, Kan.

Oct. 20-21.—Ohio State Conference on City Planning.—Annual conference, Columbus, O. Secretary, Charlotte Rumbold, Cleveland, O.

Oct. 20-21.—Engineers' Club of Philadelphia.—Conference on City Paving. H. E. Hopkins, Secretary, 1317 Spruce St., Philadelphia, Pa.

Oct. 24-28—American Society for Municipal Improvements—Annual Convention, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Nov. 14-16.—City Managers' Association.—Annual convention, Chicago, Ill. Secretary, H. G. Otis, City Manager, Clarksburg, W. Va.

Nov. 16-18.—National Municipal League.—Annual convention, Chicago, Ill. Secretary, H. W. Dodd, 261 Broadway, New York, N. Y.

Engineering Institute of Canada

The annual western meeting of the Institute of Canada was held at Saskatoon on Aug. 10, 11 and 12, with an attendance of about 150.

Among the speakers on road matters were: C. W. Dill, Superintendent of Highways, Province of Saskatchewan, who spoke upon the development of trunk highways in their relation to the western provinces: H. S. Carpenter, Deputy Minister of Highways, Province of Saskatchewan, who rendered the report of the Committee on Standard Specifications for Highways; and Pro. G. M. Williams, of the University of Saskatchewan, who read a paper on "Effect of Alkali on Concrete."

Michigan State Good Roads Association

The thirteenth annual convention of the Michigan State Good Roads Association was held Aug. 30 and 31 and Sept. 1, at Flint. Mich.

The papers presented on the first day were: "Present Road Program and a Short Look Ahead," by F. F. Rogers, State Highway Commissioner of Michigan; "The King's Highway," by P. E. Doolittle, President, Canadian Automobile Association; "The Upper Peninsula and Its Possibilities," by John A. Doelle, Member, Michigan State Board of Agriculture; "Useful Trees for Roadside Planting," by C. A. Reed, Nut Culturist, U. S. Department of Agriculture; "Agriculture as Affected by Highway Transportation," by A. H. Kroh, Akron, O.; "Michigan Pike Association and Its Tours," by Capt. W. S. Gilbreath, Manager, Detroit Automobile Club; "National Highways," by J. A. Rountree, Manager, U. S. Good Roads Association; "Genesee County Road Program," by Fred Ottaway, Chairman, Genesee County (Mich.) Road Commission; "Is the United States Safe?" by S. M. Johnson, Manager, Lee Highway Association.

The second day was given over to the State Highway Department, the following papers being presented: "1921 Road Legislation," by Levi H. Neilson, Deputy State Highway Commissioner; "Road Construction in 1921," by L. H. Belknap, Chief Engineer; "Roadside Development," by C. F. Boehler, Landscape Engineer; "Trunk Line Maintenance," by G. C. Dillman, Maintenance Engineer; "Federal Aid to States," by P. St. J. Wilson, Chief Engineer, U. S. Bureau of Public Roads. In the evening motion pictures showing the use of road machinery and the production of road materials were shown.

On the last day three papers were given: "Our Industrial Development," by J. Dallas Dort, Flint, Mich.; "The Tomorrow of Motor Truck Transportation," by Forrest J. Alvin, Detroit, Mich., and "Highway Transportation from the Manufacturers' Viewpoint," by R. E. Chamberlain, Packard Motor Car Co., Detroit, Mich.

Exhibits of road machinery and materials were grouped in the streets about the convention hall.

Engineer's Club of Philadelphia

A meeting on "City Paving" will be held by the Engineers' Club of Philadelphia, Pa., on Oct. 20 and 21, with the cooperation of the civil engineering department of the University of Pennsylvania and the engineering departments of Baltimore, Philadelphia and New York. Five sessions will be held, with two principal speakers at each session.

The Cambria County, Pennsylvania, Supervisors and Good Roads Association held its annual outing at Woodland Park, near Ebensburg, on Aug. 17, with an attendance of nearly 1,000.

PERSONAL MENTION

A. W. Vincent has been appointed city engineer of Albany, Ga.

Charles A. May has been appointed state engineer of New Mexico.

W. R. Scheiner has succeeded P. G. Wakenhut as city engineer of Salina, Kan.

C. A. Vaughan has been appointed county engineer of Sutton County, Texas.

C. M. Cooper has been appointed county engineer of Crawford County, Kansas.

Erwin E. Trueblood has been appointed county engineer of Douglas County, Kansas.

C. D. Meadows has been appointed secretary of the South Carolina Good Roads Association.

John H. Skeggs has been appointed division engineer by the California State Highway Department.

C. A. Martin has been appointed construction engineer on paving and sewer work for Puyallup, Wash.

A. L. Ferver has been appointed director of public service and city engineer ex-officia of Long Beach, Cal.

Charles W. Murray, formerly City Engineer, has been appointed acting director of the Department of Public Service, Miami, Fla.

Roy J. Rich, formerly county surveyor of St. Louis, County, Minnesota, has succeeded S. B. Shepard as construction engineer.

Fred C. Schneider has been appointed county engineer of Middlesex County, New Jersey, at a salary of $3,450 per year and expenses.

Milton H. Freeman has been appointed acting chief engineer of New York-New Jersey Tunnel Commission during the absence of Clifford Holland.

H. G. Shirley, Roads and Sanitary Engineer of Baltimore County, Maryland, has been appointed chairman of the Good Roads Board of the American Automobile Association. Plans are now being made for the reorganization of the board.

A. Dryland, County Engineer of Middlesex County, England, is in this country studying highway engineering practice. Mr. Dryland was one of the pioneers in the employment of tar in surfacing roads, treating roads with tar in 1890. The first application of tar to roads by Mr. Dryland was not to eliminate dust or strengthen the road, but to render noiseless the steel-tired vehicles of that age.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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Concrete Roads must be reinforced

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CITIES

	Yds.
Paragould, Ark.—	
1914 and 1915	33,700
Helena, Ark.—	
1914	11,314
1915	15,191
1916	2,975
Total	29,480
Hot Springs, Ark.—	
1909	15,819
1916	3,960
Total	19,779
Little Rock, Ark.—	
1913	6,077
1914	19,275
1915	19,693
1916	27,037
1917	4,538
Total	76,620

COUNTIES

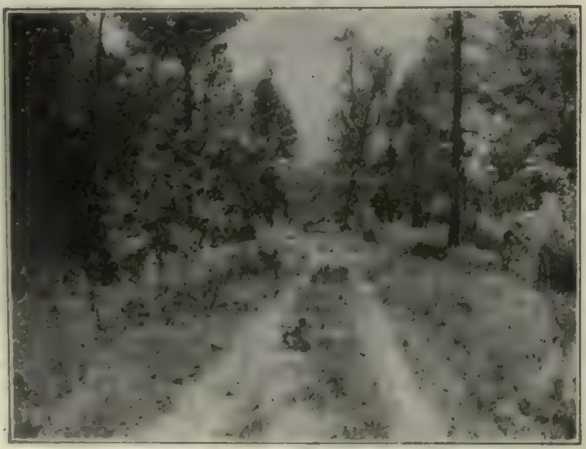
	Yds.
Arkansas County (Stuttgart), Arkansas—	
1920	39,667
1921	279,071
Total	318,738
Phillips County (Helena), Arkansas—	
1920	24,499
1921	372,288
Total	396,787
Pulaski Co. (Little Rock), Arkansas—	
1919	27,539
1920	68,477
1921	143,781
Total	239,797

UNITED STATES ARMY DEPT.

	Yds.
Camp Pike Cantonment and Remount Roads—	
1917	48,016
1918	6,794
Total	54,810

Remount-Camp Pike Road

Galloway Road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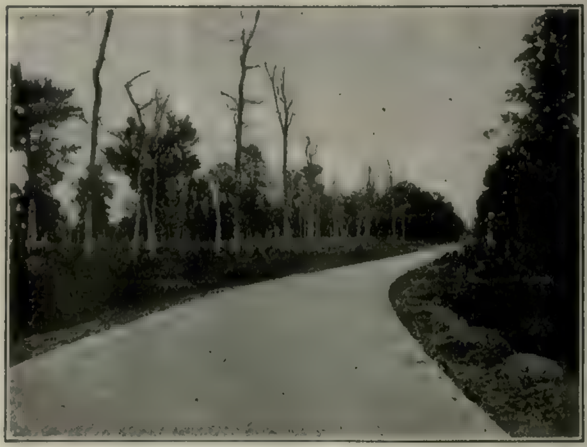
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GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE
WITH WHICH IS INCORPORATED
THE HIGHWAY CONTRACTOR AND ROAD BUILDER

Vol. LXI. NEW YORK, N. Y., SEPTEMBER 21, 1921 Number 12

The Highway Situation in Arkansas

Unconstitutionality of State, County and Municipal Bond Issues Leads to Enactment of Improvement District Laws to Permit Highway Improvement—Method of Operation Under Improvement District Plan—"Special Acts" Passed by the 1919 Legislature—Taxation for Roads and Other Purposes—Work Done and Its Cost—Work of the State Highway Department

By HUGH R. CARTER*

Under its constitution—which, in this particular respect, is not different from the constitutions of some other states—Arkansas can not issue bonds for road work, nor can its counties and municipalities issue such bonds. This made it necessary to devise other means of making the public improvements essential to the development of the many resources of the state. So far as road work is concerned, the result has been the enactment of the so-called improvement district laws.

The first law of this kind was passed in 1889 and authorized cities and towns to organize special taxing districts for the purpose of raising funds for such munciipal improvements as paving, water works, sewerage and lighting. This act authorized the restricted districts created to issue their bonds, and required that such bond be retired within 20 years. A district bond issue of this type constituted a first mortgage on all property in the district, thus securing it in the best possible way.

ARKANSAS AND HER ROADS have been much in the public eye of late. Road building methods in that state, especially the plan of financing work, have been subjects of more than a little adverse criticism. Last spring it was announced that the U. S. Bureau of Public Roads would investigate the situation. This investigation was made and the findings given publicity in this and other publications.

IN THIS ARTICLE, Former State Highway Engineer Carter takes up the defense of the state's plan of procedure and describes the laws, the methods by which they are applied and the work that has been accomplished and is being accomplished under them.

This act was thrashed out in all the courts and finally upheld by the Supreme Court, on the ground that the district was merely a taxation district and that the city was not lending its credit for the purpose outlined in the act, but that the improvement was purely a benefit to the property being taxed. In other words, the property was benefitted as much as it was paying, thus avoiding the tax or bond feature which is prohibited by the constitution.

In due course of time the same principle of law was applied to the construction of levees along the state's numerous streams in order to protect some of the richest farm lands in the world from overflow. Later it became necessary to take care of surface water, and the same principle was applied to the formation of drainage districts.

After the rich bottom lands of the state had been protected and drained, the importance of highways was realized by the farmers and landowners.

County road taxes were so small that funds were seldom available for even temporary or partial improvements. As a result, in 1913 the Legislature turned its attention to the construction of hard-surfaced roads. The problem was solved by again applying the improvement district principle by the passage, in 1915, of a general law, known as the Alexander Law.

Under this statute, the owners of property abutting on a road—and usually those owning property within 3 mi. of the road on each side—could petition the county court for the organization of a road improvement district. The district could be organized if the petition carried the names of a majority of the owners, the majority being determined by

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*Consulting Engineer, Little Rock, Ark.; Former State Highway Engineer of Arkansas.

AN ARKANSAS COUNTY ROAD NEAR STUTTGART, BEFORE IMPROVEMENT

GRADING PARTLY COMPLETED ON ONE OF THE ROADS IN ARKANSAS COUNTY

numbers, acreage of land owned, or value of land owned. If a petition carried the required majority, the court appointed three of the landowners as commissioners and these commissioners employed engineers for preparing plans and estimates. The data gathered were then filed with the court and hearings were held. If no material objections developed, the court approved the plans, specifications and estimates and appointed assessors, who had to be landowners residing at least within the county, to assess the benefits accruing to the land embraced in the proposed district in accordance with the plans and specifications. After this had been done the district could issue its bonds, up to 30% of the assessed value of the property involved and payable within 30 years.

When determining the benefits accruing to any individual parcel of land, the assessors would usually take into consideration three conditions: First, its proximity to the road; second, its assessed value; and third, its development. The smallest tract considered was 40 acres. A zone map was generally prepared, the abutting property being divided usually into three zones on each side of the road. The zone adjacent to the highway naturally paid a larger tax than that in a zone 3 mi. distant.

After operating under this law for three or four years, the landowners began to demand improvements faster than it was possible to organize the improvement districts. It then developed, also, that the law would not permit the organization of a district lying in more than one county, thus preventing the improvement of a continuous highway. To overcome these handicaps, the 1919 Legislature, at its regular session and at a special session, passed more than one hundred "special acts" organizing road improvement districts over the entire state.

These "special acts" are not different from the Alexander Act, except that the landowners do not petition for their passage. After a district has been organized under one of them, the owners of land affected have the same right to be heard as under the Alexander Act; and also the same rights in respect to taxation and bond issues.

This outline of the road laws of Arkansas will indicate the handicaps under which the state has

MIXING PLANT AT STUTTGART, ARK., EMPLOYED ON THE WORK IN THE NORTHERN ROAD IMPROVEMENT DISTRICT OF ARKANSAS COUNTY

MOTOR TRUCK DUMPING MATERIAL FOR A CRUSHED STONE BASE

ARKANSAS COUNTY ROAD AFTER COMPLETION OF CRUSHED STONE BASE

labored in developing a highway system. In spite of their disadvantages, the laws seem fairer than those of some of the states where entire counties, and land far removed from a road pay the taxes, for, after all, the lands nearest the road receive the greatest benefit. The laws could be improved if it were permissible to assess personal property and levy taxes upon it within the districts, and a constitutional amendment making such provision is now before the people.

A great deal has appeared in the press that would indicate that Arkansas is virtually bankrupt because of road and other taxes. As a matter of fact, a comparison of the assessed values and tax rates of Arkansas with those of other states will show that Arkansans pay less than the people of almost any other state, although they are building one of the most comprehensive highway system in the union.

For instance, the total of the state, county, city and school taxes in Stuttgart, Ark. (to which city further reference will be made), is 32.7 mills, while the road tax in the district in which the city is situated is 44.84 mills, making a grand total of 77.54 mills. Reducing this rate to a full valuation basis would give 15.5 mills, or $1.55 per $100. Comparing this with the rate of $2.77 per $100 for all purposes in New York City, shows a difference of $1.22 in favor of the Arkansas taxpayer. Similar comparisons with Dallas, Texas, and Los Angeles, Cal., show differences in favor of the Arkansas city of $0.37 and $0.50, respectively.

Investigations in a number of other places bear out the contention that taxes in Arkansas—even including road taxes in localities where expensive, high class roads are being built—are less than those in any state in which any material improvements are being made. Arkansas deserves still further credit because personal property bears no taxes for improvements, as it does in all of the states specifically mentioned in the foregoing.

It has been alleged that in Arkansas money has been wasted and that the overhead, engineering, legal and other expenses in the road improvement districts have been exorbitant. If this is true, it is true of very exceptional cases. It is by no means generally true, for the total of administrative, en-

LAYING WARRENITE-BITULITHIC WEARING SURFACE ON AN ARKANSAS COUNTY ROAD

COMPLETED WARRENITE-BITULITHIC PAVEMENT —NORTHERN IMPROVEMENT DISTRICT gineering, legal and commissioners' expenses in the average district is less than 9%. And that figure includes the cost of maintaining the State Highway Department. Corresponding figures for other states, insofar as it is possible to analyze their overhead charges, are as follows: California, 12.5%; Connecticut, 12.5%; New York, 10%; Louisiana, 9%; Oklahoma, 8%.

It was stated in the eastern press several months ago that Arkansas improvement districts would not be able to take care of their indebtedness. The records of the month of August, the last tax paying period, are sufficient to prove the untruth of that prediction. No bonds were defaulted and all payments, interest and otherwise, were met promptly. Statistics will prove that in Arkansas there has been paid a greater percentage of the taxes than in many other states and that as large a percentage has been paid as in any state.

As a typical example of the character of work being done in Arkansas improvement districts, the Northern Road Improvement District of Arkansas County may be cited.

This district includes and surrounds the City of Stuttgart—to which reference has been made—and comprises approximately 220,500 acres, of which at present about 90,000 are being intensively cultivated in rice. A large increase in the rice area is expected when the district's road system is completed, but at present the remainder of the land under cultivation is devoted to cotton, corn and other staples.

The road system planned for the district embraces 75.9 mi., of which 35 will be of Warrenite-Bitulithic and 40.9 will be of high class, two-course gravel. The former will consist of a water-bound macadam or rolled stone base, 7 in. thick after compaction, and a 2-in. Warrenite-Bitulithic wearing surface. The pavement will be 16 ft. wide. The gravel roads will be 14 ft. wide and 8 in. thick, compacted. All fills will be 22 ft. wide on top and will be at least 1 ft. higher than the surrounding rice lands.

The work is being done by contract and under the general supervision of the State Highway Department, the writer being the engineer for the district. The specifications were approved by the U. S. Bureau of Public Roads and the contracts were approved both by the Bureau and the State Highway Department. Federal aid to the amount of $137,500 has been alloted to the work and the agreements have been signed. All materials used are tested at the writer's laboratory at Stuttgart, and every effort is being made to secure work of the highest type.

Bids were received on cement concrete pavement; Warrenite-Bitulithic top on cement concrete base or on rolled stone or water-bound macadam base; asphaltic concrete (Topeka) on cement concrete or rolled stone base. As there is no frost in the locality, and as the Warrenite-Bitulithic top on a rolled stone base was the cheapest, that type was selected. Some of the unit prices in the bid were as follows: Excavation, one-way pay, 46 ct. per cubic yard; Class A concrete in small reinforced culverts; $29.00 per cubic yard; Warrenite-Bitulithic surfacing, $1.85 per square yard; water-bound macadam or rolled stone base, $1.33 per square yard. These prices are for the materials in place on the road, and from investigation it is found that they compare very favorably with prices in other places, being materially lower in general.

The Warrenite-Bitulithic pavements are costing about $34,000 per mile, including grading, draining, base and wearing surface, and the gravel roads, including the same items, are costing about $16,500 per mile. Crushed rock and sand are obtained at Little Rock, the prices f. o. b. that city being $1.50 per ton and $1.00 per cubic yard, respectively. The hauls from the railroad sidings in Arkansas County to the job average 3.5 mi. Gravel comes from Millville, Ouachita County, and costs 50 ct. per ton, f. o. b. at the pit. The haul averages 5.5 mi. The freight rate in both cases is 4 ct. per 100 lb.

The Northern Road Improvement District of Arkansas County is a progressive community. The land is being cultivated intensively, the principal crop, as has been noted, being rice. The normal yield is about 1,500,000 bu. and this represents about 25% of the tonnage to be hauled over the roads now under construction. In any rice growing section the highway problem is an exceedingly difficult one, a great deal of study and experience being required to develop economical and substantial roads. Careful study of conditions in Arkansas County indicated that proper drainage was the first consideration and, with that in mind, a drainage system was developed that will be worth to the farms adjoining the roads at least 50% of the cost of the road work, for it has made possible the cultivation of land that had never been cultivated before. The traffic within the district is at least 85% motorized, thus, especially in the absence of any suitable local material, eliminating from consideration any of the cheaper types of roads. The development of the community undoubtedly justifies the selections made. A less substantial type, under the existing conditions, would be a liability rather than an asset.

The work being done in the district is typical of the high class of work being done throughout the state, and forms part of a predetermined and prearranged state highway system. The total expenditure for the Northern Road Improvement District work will be approximately $2,000,000, and great credit is due the contractors, the Miller-Butterworth-Gregory-Wilson Co., for the manner in which they have handled the contract. So far as the writer can ascertain, they were paid the highest estimate ever paid in the United States for a single 30-day

(Continued on page 154)

The Measurement of Impact[*]

Actual Force of Impact Difficult to Measure—Special Apparatus and High Degree of Skill Required—Autographic and Deformation Methods—Theory of the Determination and Apparatus Used—Value of Results

By EARL B. SMITH[†]

The measurement of the actual force of impact is accompanied by a great many difficulties and requires special apparatus used with a high degree of skill. It is also rather difficult to know when the actual maximum value of the force has been obtained. Several methods have been used in attempts to determine the force of an impact blow and it is the purpose in this paper to describe two of these methods, namely, the autographic and the deformation methods.

Our usual conception of the force of a blow is in terms of work or energy, but to make actual use of the force of impact in comparing effects, and in the design of structures and machine parts, we must know the actual intensity of the blow in pounds and not in foot-pounds.

The fundamental formula for the energy in a moving mass,

$$K = \frac{MV^2}{2}$$

does not show the actual force in pounds with which this mass may strike another mass. We may know the actual force of the blow only when we determine the time and distance in which the mass is brought to rest. In other words, we must know the rate at which the velocity of the mass is changed. This rate of velocity change from some value to a lesser or to a zero value is known as deceleration. The numerical value of decelation may be known from the relation

$$a = \frac{V_1 - V_2}{t}$$

That is, deceleration is equal to the difference between an initial velocity, V_1, and the final velocity, V_2, divided by the time, t, to make this velocity change. V_2 is equal to zero in most cases with which we are concerned.

The actual force of impact in pounds is given by the formula

$$F = Ma = \frac{W}{g} a$$

In the use of this formula the value of the acceleration of gravity is known, that is, $g = 32.2$; the weight of the mass, W, in pounds may be readily obtained; but the value of the deceleration, a, is very difficult to determine. Its determination requires very accurate measurements of small increments of time and distance. This formula is, however, the basic relation between impact and force, and it is only by this relation that we may hope to secure accurate results.

When one mass strikes another the force of the blow depends upon the deceleration value. If the velocity of the moving mass is changed to zero in a very short time the resulting force is larger than when the velocity change is over a longer period of time. The time of velocity change is, in turn, dependent upon the distance through which the change takes place.

Consider for a moment a weight of known value falling from some known height. If this weight is suddenly brought to rest when striking a hard practically immovable mass the force of the blow in pounds will be very high, its exact value depending upon the deformation of the materials of the two bodies. But if this same weight, falling from the same height, strikes another body which is not so hard and may possibly move slightly under the impact, the resulting force of impact in pounds is much less. Again, under the same conditions of weight and height or fall, if the weight strikes a spring or a block of rubber the deceleration value is further decreased from the value in the other cases, with the result that the impact force in pounds is comparatively small. In all these cases the amount of energy possessed by the moving body in foot-pounds at the instant of contact is the same. From this it may be readily seen that the amount of energy possessed by a moving body is in no way an indication of the force of impact in pounds, but that the force is dependent upon the resistance and the deceleration value.

The only way in which the value of the force of impact, in pounds, may be determined accurately is by the use of a "space-time" curve autographically drawn at the instant of impact. That is, the movement and position of the mass (or weight) must be graphically indicated with respect to each time increment.

By Fig. 1 is shown diagramatically the essentials of the apparatus which has been used by the U. S. Bureau of Public Roads to obtain the autographic space-time curve. The recording drum carries a sheet of paper and revolves at such a speed as to give the paper a circumferential velocity of about 30 in. per second. The magnetic time recorder is in series with the operating magnet of the tuning fork, and makes an oscillating time record line, "T," on the paper, indicating 0.01 second for each 0.3 in. of paper record. By interpolation it is easy to get time intervals of less than 0.001 second.

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[*] Paper presented at the 24th annual meeting of the American Society for Testing Materials, Asbury Park, N. J., June 20-24, 1921.

[†] Senior Assistant Testing Engineer, U. S. Bureau of Public Roads.

The falling weight, "W," carries an extension, "E," which engages with the pencil arm, "P," and causes the pencil to trace the exact movement of the weight just before and during contact. For weights falling more than a few inches this scheme has been found satisfactory, since it is the maximum deceleration value which is desired. This maximum value occurs, of course, during contact, and in the cast of soft or yielding materials it occurs just before but near the final point. It is sometimes possible and more convenient to connect the guide rod, "A," directly to the weight and thus obtain a record of the entire movement. This is done in the case of determining the impact of a truck wheel on the road. In the use of such in instrument precaution must be taken to prevent any lost motion in the apparatus, and to prevent any natural periods of vibration in the pencil arm and connections. An ink pen is not suitable for tracing the records. It is absolutely essential that the line be traced by a sharp, hard pencil lead on ledger paper, or by a bronze point on silicated paper.

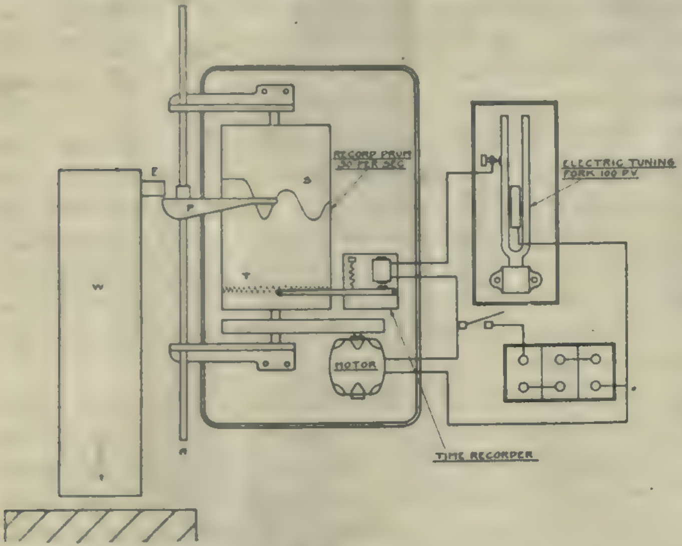


FIG. 1

The curve in Fig. 2 is a reproduction of the space-curve of the vertical movement of a truck wheel autographically drawn by this apparatus. The vertical ordinates are the actual distances passed over by the wheel; and the horizontal distances represent time intervals. An enlargement of the lower part of a theoretical curve is plotted in Fig. 3, for the purpose of showing the method of obtaining the final deceleration value. To the "space-time" curve, "A," (Fig. 9), are drawn several tangents, as "ta." The values of these tangents, to the scale of the two axes, are plotted in curve "B" to the same time axis and above each corresponding tangent point. This gives a "velocity-time" curve, showing the velocity at any time. Likewise, tangents to this latter curve are plotted in curve "C;" this gives "deceleration-time" curve, showing the deceleration at any time. In this particular case the space-time

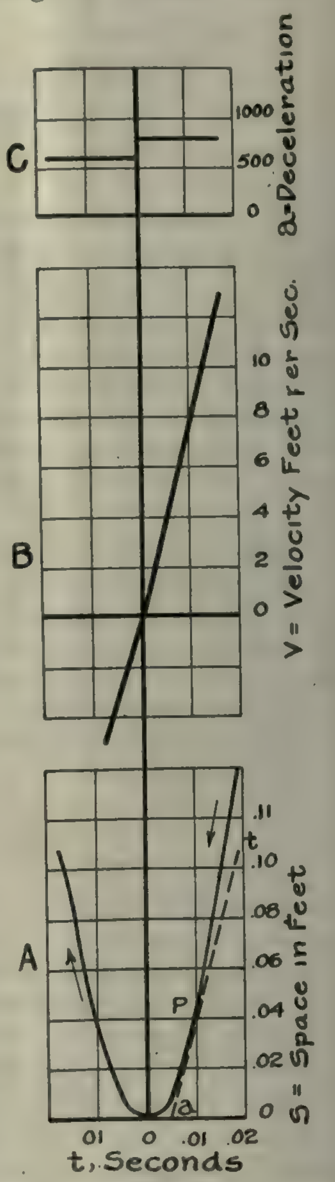


FIG. 3

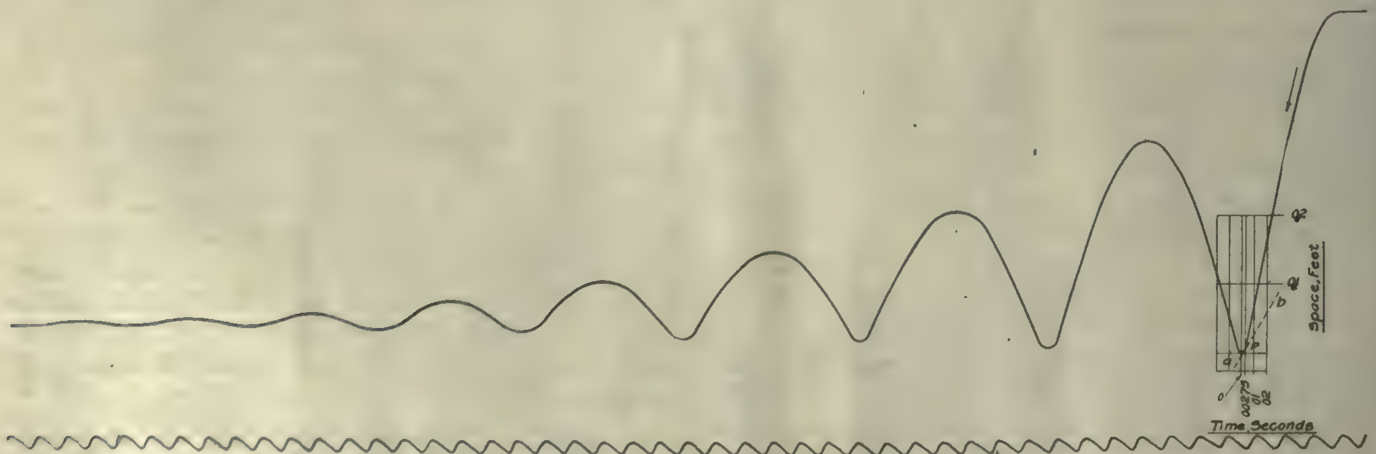


FIG. 2

curve (downward portion) was a parabola whose equation is

$$t^2 = .00258$$

and since values of the tangents to a true parabola are directly proportional to the abscissae, the velocity curve "B" is a straight line; also since this is a straight line its tangent is a constant, giving the horizontal lines at "C." The upward portion of this curve has a slightly different equation.

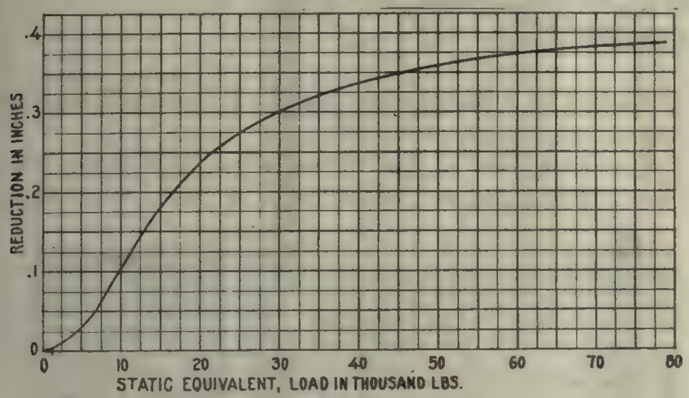


FIG. 4

This graphical solution is based on the fact, that on the space-time curve any point represents the distance passed over at that time, or the velocity; that is, the first derivative,

$$dV = \frac{ds}{dt} = \textit{tangent to the curve}$$

Also, it may be proven that the first derivative of the velocity curve, or the second derivative of the space-time curve is the deceleration.

Taking the values of the coordinates at the point "P," and from the equation of the curve

$$da = \frac{d^2s}{dt^2} = \frac{d^2\ t^2}{(.0025)\ dt^2} = 800$$

which corresponds to the graphical value.

Referring again to Fig. 2, tangents drawn to the space-time curve, as "ab," show a maximum value for the deceleration of 1,400 ft. per second per second. Then from the fundamental equation, $Ma = F$, when W is 2,000 lb., the resulting impact force is

$$F = \frac{2000 \times 1400}{32.2} = 87{,}000 \text{ lb.}$$

This autographic method may be found convenient for use where weights are large and movements are comparatively slow, and where the deceleration values are probably not over 5,000 ft. per second per second. It should be satisfactory for use in determining the impact of truck wheels, pile drivers, forging hammers, or any large mass striking a yielding substance or support. This method would be somewhat difficult to use where the velocity of the mass is high, and the mass strikes a hard and only slightly yielding substance or support.

No very simple method of determining impact values that will give absolutely definite results has as yet been devised. A method for obtaining approximate comparisons of impact forces in pounds is based upon the fact that both impact and static forces may be made to produce deformations. This method consists simply of receiving the impact on a small copper cylinder, and of comparing the deformation thus produced in the copper with the static force which will produce the same deformation on a similar clyinder. Since equal deformations will not be produced in the same material under both impact and static forces, the indications from the copper cylinder method should be corrected by the use of some coefficient. This coefficient is not a constant and depends for its value upon several factors which are as difficult of determination as the impact value itself. This method does, however, give some approximate comparisons between impacts which may be of value in studying such forces when the variation in weight and height of fall is not very great.

A serious disadvantage in the use of this copper cylinder method is that it introduces another factor in the result: The cylinder itself acts as a cushion, giving more deformation or deflection to the system and thus reducing the deceleration. When definite impact values are desired they are required under the actual conditions without cushioning effect, and it should be remembered that the measurement of this force by the copper cylinder method gives results that may be considerably less than actual values.

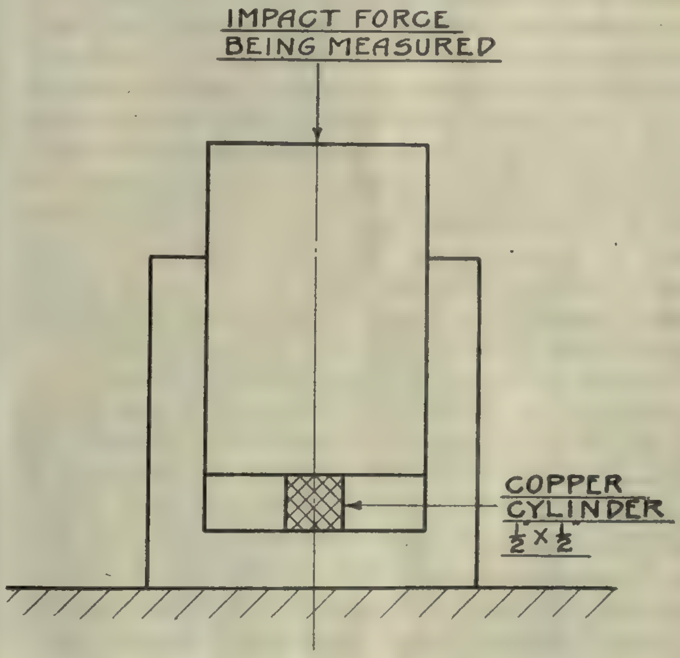


FIG. 5

(Continued on page 154)

Determination of the Bearing Power of Soils Under Repeating Loads

Descrption of the Apparatus and Method Devised by the Testing Laboratory of the Division of Highways of Illinois Department of Public Works and Buildings

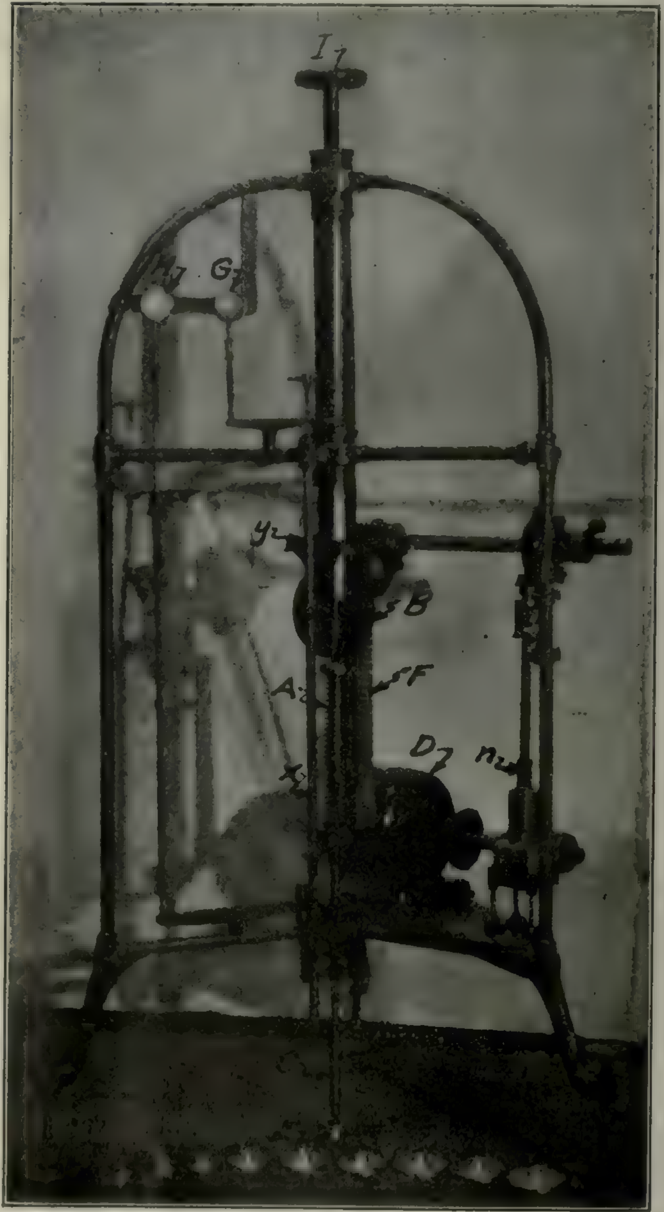
By H. F. CLEMMER*

In an attempt to determine the action of the subgrade under hard-surfaced roads when subjected to repeated loads, such as would be caused by the movement of heavy vehicles on the surface, the Illinois Testing Laboratory has designed a new apparatus termed the "repeating load bearing power determinator."

It has been found that the pressure to which a subgrade under a hard-surfaced road is subjected can be of three kinds, depending upon the way in which the load is applied to the surface. If the surface is rough or if a truck wheel hits an obstruction, an impact force is produced, while if a truck stops for any appreciable length of time a static load is occasioned on the subgrade. The action of the subgrade under these two classes of loads is being studied by use of the Goldbeck impact bearing power determinator and the Illinois static load bearing power determinator. The Illinois repeating load bearing power determinator is being used for making a study of the subgrade when subjected to a third condition—that of a great number of vehicles passing over the surface. The first two devices allow a study of the subgrade when subjected to impact and static loads while with the third device the subgrade action can be noted when subjected to a load increasing from zero to a maximum and then decreasing back to zero again in approximately the same time, and of the same magnitude as would be occasioned by a heavy motor truck wheel maving over a rigid surface.

Briefly described, the determinator, shown in the accompanying illustration, consists of a pipe frame in which are mounted: a spring (A) for producing pressure; a cam (B) which varies this pressure; a plunger (C) which transmits this pressure to the soil; a 1/6 hp. D. C. motor (D) which drives the cam at a constant speed of 6 revolutions per minute; a footing (E) which is attached to the bottom of the plunger and distributes the pressure to the soil (footings of different areas are shown at the bottom of the machine in the illustration); a scale (F) upon which the pressure desired is set; an Ames dial (H) which registers the action of the soil under the repeating loads; a wheel (I) which lowers the cam section; and a second Ames dial (G) which registers the vertical movement of this section. Motor power is furnished by a power unit carried on the truck which transports the determinator.

The first step in the operation of the repeating load bearing power determinator is to level up the entire apparatus and make the plane of the footing on the bottom of the plunger parallel with the surface of the soil. By means of loosening set screw (n)



ILLINOIS REPEATING LOAD BEARING POWER DETERMINATOR

(Continued on page 154)

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*Testing Engineer, Division of Highways, Illinois Department of Public Works and Buildings.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

Founded January, 1892

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Copy for classified and other advertisements where proofs are not required will be accepted until noon on Monday of the week of issue.

Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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ARKANSAS HIGHWAY WORK

Road builders who have followed the controversy over the road laws of Arkansas and the work done under them will find much of interest in the article by H. R. Carter, which is printed on other pages of this issue.

For some time, taxpayers in various Arkansas improvement districts have complained of excessive taxation and of other objectionable features of road improvement in the state. Matters came to a head last spring when the U. S. Bureau of Public Roads took official cognizance of these complaints by ordering an investigation of the entire situation.

According to a report submitted by engineers of the bureau after a study of the Arkansas laws and their operation, there were grounds for serious adverse criticism of the administration of road affairs in the state, especially in some of the improvement districts created by special legislative acts. It was shown, however, that the Federal Government's interests had been amply protected, though always with greater and greater difficulty.

As a result of the findings of the bureau's engineers, certain recommendations were made to the state officials with respect to the conduct of federal aid work and the maintenance of federal aid roads after completion. The bureau also advised the state officials that until the matters criticised were corrected payments for federal aid work would be made only upon the completion of projects and that further federal aid projects would not be approved until certain specified maintenance work had been taken care of properly.

Mr. Carter was state highway engineer of Arkansas until about two years ago, when he resigned to enter private practice. He is now consulting engineer on some of the most extensive work being done in the state and is, therefore, in an excellent position to speak with authority. In the article to which reference has been made, he covers the Arkansas situation thoroughly and in considerable detail.

Road in China to Cut Hauling Cost 75% It costs $26.50 to haul a ton by cart from the Yellow River to Fenchowfu, China. The American Red Cross is building a road, which, when completed, will effect a saving of $20 a ton, according to the engineers. In the course of a year the total saving will amount to approximately $5,000,000.

The Texas Program With about $30,000,000 of state and federal funds available, Texas has some 2,500 mi. of road under construction, according to a recent statement from the State Highway Commission. This is no mean program, for in spite of her great area the Lone Star State has a low density of population and an enormous road mileage.

The Pacific Highway Peace Portal Early this month the Peace Portal on the Pacific Highway where it crosses the Canadian line near Blaine, Wash., was dedicated with fitting ceremony. It is "the first arch to be erected in the world to celebrate peace," according to Samuel Hill, who was responsible for the sucess of the movement culminating in the ceremony on Sept. 6.

Funds for Highway Research The need for highway research far exceeds the funds available for it. There are many directions in which studies and experiments should be extended; and most of the necessary work is expensive. The funds available for prosecuting the work are decidedly limited. A man of wealth who wished to devote his money to a strictly utilitarian, but none the less worthy, cause could not do better than to endow an institution for highway research.

A Bridge and Politics Last week a cracked gusset plate in a bridge at Chester, Pa., broke under the strain of an unusual crowd on the footpath with the result that 24 of the crowd were drowned. According to newspaper reports, the incident is being utilized as political ammunition, one faction charging the other with responsibility for the condition that led to the disaster. The one mitigating circumstance in the whole affair is that such criticisms as have been made have been leveled at political office holders and not at engineers.

The Highway Situation in Arkansas

(Concluded from page 148)

period on any one road job, the estimate for the month of May having been $223,000.

The Arkansas State Highway Department, while the writer was state highway engineer, outlined a complete state highway system of 5,500 mi. Work completed, work under construction and work for which contracts have been awarded in districts now in existence embraces approximately 3,200 of these 5,500 mi. Yet the eastern papers allege that the work done and being done is disconnected, consisting of a series of small projects! As a matter of fact, if the present progress continues, every county seat will be connected and a state highway system will be completed within the next five years—which will be considerably in advance of most states in the Union.

The Measurement of Impact

(Concluded from page 151)

Where only comparisons are desired, and not the actual values, this copper cylinder method may be found convenient and reliable. The cylinders are made from a pure copper rod ½ in. diameter, cut and accurately machined to 0.500 in. in length; allowing a variation of not more than 0.001 in. It has been found that the diameter of rolled copper rods is sufficiently constant and accurate to require no further machining. These cylinders are heat treated in a gas or electric furnace in a bath of molten sodium and potassium nitrate crystals, in the proportion of 4 to 1, respectively. After the crystals are melted, requiring about 1,200° F., the copper cylinders are carefully dropped into the bath and allowed to remain there for 30 minutes. The bath and contents are then removed and allowed to cool to atmospheric temperature, after which the cylinders are removed by dissolving the nitrate crystals in warm water. A few of these cylinders are tested in a testing machine, under static loads, and an average curve of "load vs. deformation" is plotted, as shown in Fig. 4. For use in measuring impact one copper cylinder is placed under the plunger in a neat but loose fitting cylinder (Fig. 5), and the impact is received on the head of the plunger. The resulting deformation in the copper cylinder is measured with a micrometer and the "equivalent static force" is read from the curve (Fig. 4).

Of the two methods described the autographic method is more accurate and reliable; the results are probably not more than 2% in error. It does, however, require a recording apparatus and a timing device which is not readily secured from any of the manufacturers of physical apparatus. The apparatus used by the author in the laboratories of the U. S. Bureau of Public Roads was made especially for the purpose by the Bureau instrument maker for use in connection with an investigation to determine the impact of trucks on roads.

The copper cylinder method has been used to a rather large extent in the determination of the impact of trucks; it does not give actual results. The results by this method should be considered only as comparisons, but the comparisons are reliable and useful when dealing with weights and distance which do not have a larger variation than about 5 to 1, and when the estimated deceleration is probably not over 3,000 ft. per second per second.

Determination of the Bearing Power of Soils Under Repeating Loads

(Concluded from page 152)

and applying a crank to the shaft leading to the cam, the pointer on the upper end of the spring is set approximately to the pressure desired. Fine adjustment of the pressure can be made by turning the lower bearing upon which the spring rests. Set screw (n) is then tightened and the power unit attached. The motor, in causing the cam to revolve, varies the pressure on the soil from zero to the maximum and then back to zero again six times per minute. As the soil is deflected under the pressure applied, it is necessary to lower the cam section in order that the pressure remain constant. This lowering movement is accomplished by turning wheel (I) and is registered on dial (G). Dial (H) registers to the 10,000th part of an inch the action of the soil beneath the footing.

In order that the soil might be permitted to recover from the pressure without being opposed by the dead load of the plunger-section, it was necessary to design an attachment which would carry this load immediately after the pressure was released. A shaft (x) and a counter cam (y) were attached to the frame to pick up this load and carry it until just before the pressure is again applied.

Variable sized footings are being used in order to get some relationship between the action of the soil under loads applied to different areas. The loads applied to these footings vary between 5 and 50 lb. per square inch.

This apparatus is at present being used in the subgrade investigational work carried on in connection with the Bates experimental road. With the cooperation of the U. S. Bureau of Public Roads an attempt is being made to correlate the results obtained in the field with the soil bearing power values as indicated by experiments carried on in the laboratory at Washington.

◆

The U. S. Department of Agriculture uses more than 2,000 motor vehicles.

Rural Schools in 16 states operate 12,000 motor buses, transporting more than 200,000 children.

Road Work in Texas

The State of Texas has 2,500 mi. of road under construction, according to R. M. Hubbard, Chairman of the State Highway Commission, with $30,000,000 of state and federal funds available for this work. The amount of work completed under the direct supervision of the State Highway Department during the first seven months of this year amounted to $12,550,508.

Bridge Failure Drowns 24

Gusset Plate on Chester, Pa., Bridge, Long Known to be Defective, Causes Great Disaster

Twenty-four persons were drowned and several seriously injured in the collapse of a section of footpath on the Third Street Bridge over the Chester River at Chester, Pa., on Sept. 11. The section of the footpath collapsed when several hundred people gathered upon it to watch the recovery of the body of a drowned boy.

The cause of failure, H. H. Quimby, Chief Engineer of the Philadelphia Rapid Transit Co., is quoted as having explained as follows: "The gusset plate which supports one of the side arms, which in turn supports the footpath, was made of wrought iron. The bridge was faulty in construction. The grain in the plate was perpendicular instead of being horizontal, and we found a crack in the plate nearly 8 in. in length. The length of the gusset plate, which gave way, was 15 in., and the old crack in the plate was 8 in. and had been there for eleven years. It is what we call a progressive break."

Ten years ago, it is said, a boat jammed against the bridge, bending the gusset plate. The plate was removed and in the effort to straighten it, the plate was cracked. Despite the crack, the plate was put back and bolted into place, instead of being riveted, according to reports.

Highway Business

We are accustomed to regard private corporations alone as coming within the category of "big business." But certainly the business of constructing the public highways of the United States, involving the annual expenditure of perhaps a billion dollars, deserves the same appellation—highway construction is undoubtedly "big business." A few years ago we were astounded when the budget of the National Government reached a billion dollars; today that sum is available for the construction of highways alone.

There was a time when business did not pay its hired managers the large salaries now customary. We did not then have the large business structures that exist now, we did not have the problems of management which involved such huge sums as are required to carry on big business today. We can appreciate in these days how a man can be worth twenty-five, fifty or a hundred thousand dollars a year to big business. But we have not yet fully appreciated the fact that our public highway program is itself big business and that it requires big men to run it. Contrast this outstanding fact with actual conditions.

A billion dollars for highway construction is an average of about twenty millions for each state. The average salary paid to the chief highway engineers in the 48 states is $5,372 per annum; the maximum is only $10,000 and the minimum is $3,000. These salaries are not those of 20 years ago, when the highway was usually a country mud road, but are actual salaries being paid today. We are running a 20 million dollar a year business in each state with a $5,000 a year man.—*"Professional Engineer."*

Red Cross Builds Chinese Road

Highway Built by Americans Will be Great Aid in Development of Transportation

Indicative of the economic value of the highways constructed in China by the American Red Cross is the report of John Earl Baker, Director of the American Red Cross Relief in China, showing that the road from the Yellow River to Fenchowfu will result in a decrease of $20 per ton in transportation costs.

"Inspection of the records at the customs stations on the Yellow River Road," says Mr. Baker, "show that there is an average of 700 tons daily passing over that line. The present cost of haul from the Yellow River to Fenchowfu is $26.50 a ton. Our engineers estimate that, conservatively, one animal hitched to a cart passing over our roads when completed will carry a load equal to that now carried by four animals with less danger to animal and cargo. Very frequently these animals slip on the passes and either fall from the cliffs or so injure themselves as to be of no further value. At this rate a saving of nearly $20 a ton will be made by the use of our road. This will amount to practically $5,000,000 annually.

"Both of our roads in Shansi, passing through mountainous country, have excellent promise of permanency: First, because of the fact that no narrow tired carts are available, the government's order that only broad tired carts are to be used has every promise of successful enforcement; second, a good quality of rock and gravel is available for surfacing. In Shantung and Chili, the work of upkeep will depend largely upon the effectiveness of the maintenance organization."

Highway Accidents in Paris last year totaled 60,375—an average of 165 daily.

Seven States in the Country register motor trucks at the same rate as passenger cars.

EQUIPMENT--TRADE--MATERIALS

Ohio Road Building Contractors Work Night Shifts

As on the big road contract in Maricopa County, Arizona, an account of which was printed in "Good Roads" for Aug. 10, night shifts are being utilized in an effort to complete an Ohio road contract during the present season.

NIGHT SHIFT AT WORK ON A CEMENT CONCRETE PAVING JOB IN FULTON COUNTY, OHIO

The Ohio work is on the Bryan-Wauseon Road in Fulton County, and the contracting company is Lewis & Copeland, of Lima, Ohio. The contract is for the construction of 6.2 mi. of concrete pavement, and two 8-hour shifts of 30 men each are employed. The pavement is 16 ft. wide and each shift is now laying about 400 lin. ft. daily.

The accompanying illustration shows night work being done with the aid of carbide lights. These are to be replaced by an installation of the Willys Auto Light system and the number of shifts increased to three, with the expectation of putting down about 1,200 lin. ft. of pavement every 24 hours.

The Havelock Maintainer

A circular describing the Havelock road maintainer has been issued recently by the maker of this machine, which has found extensive use in road maintenance in Nebraska and other western states. The machine consists of a steel frame on which is mounted an adjustable sectional steel blade at an angle of 40 deg. Besides being used in the maintenance of earth roads, the machine can be used in clearing snow from the roads. The Havelock maintainer is manufactured by the Highway Maintainer Co., Havelock, Neb.

Manufacturers Cut Cement Prices

Following a reduction of 30 ct. per barrel in the price of cement by the Atlas Portland Cement Co., other cement manufacturers have made similar reductions. Important savings have been made in manufacturing costs, according to L. B. Burch, of the Atlas Portland Cement Co., because of greater efficiency among the mill employees.

Rogers Road Planer

A circular describing and illustrating the Rogers road planer is being sent out. This planer is made of angle steel with cutting blades arranged so that the earth is pulled toward the center of the road. Two sizes of the plane are made, one with 10 cutters, weighing 800 lb., and one with 6 cutters, weighing 450 lb. The Rogers planer is made by the Rogers Bros. Co., Albion, Pa.

Eastern Railroads Reduce Rates on Highway Materials

Applications of railroads in the eastern trunk line district to make reductions of about 16% in freight rates on sand, gravel and stone upon five days' notice were approved Sept. 10 by the Interstate Commerce Commission. The new rates will be published to become effective Oct. 1 and will apply to interstate shipments in the territory including Pennsylvania, New Jersey, Maryland, Delaware and part of Virginia and West Virginia.

The Barrett Company has moved its New York office to its new building at 40 Rector St.

A new net price list has been issued by Kolesch & Co., 138 Fulton St., New York City, dealers in engineering supplies. In the revised price list net prices without discounts are published.

"What's Your Truck Doing All Day?" asks a folder being circulated by the Service Recorder Co., Cleveland, O., manufacturer of the Servis recorder, a device which registers the running and idle time of motor trucks.

◆

Automobile Salesmen in the United States total approximately 100,000.

The State of Kansas has road projects under way amounting to $23,643,754; Iowa, $19,733,025; Missouri, $9,648,177; Nebraska, $8,092,376.

MEETINGS

Calendar of Coming Meetings

Oct. 10-12—North Carolina Good Roads Association.—Annual convention, Greensboro, N. C. Secretary, H. M. Berry, Chapel Hill, N. C.

Oct. 12-14.—League of Kansas Municipalities.—Annual convention, Lawrence, Kan. Secretary, John G. Stutz, University of Kansas, Lawrence, Kan.

Oct. 20-21.—Ohio State Conference on City Planning.—Annual conference, Columbus, O. Secretary, Charlotte Rumbold, Cleveland, O.

Oct. 20-21.—Engineers' Club of Philadelphia.—Conference on City Paving. H. E. Hopkins, Secretary, 1317 Spruce St., Philadelphia, Pa.

Oct. 24-28—American Society for Municipal Improvements—Annual Convention, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Nov. 14-16.—City Managers' Association.—Annual convention, Chicago, Ill. Secretary, H. G. Otis, City Manager, Clarksburg, W. Va.

Nov. 16-18.—National Municipal League.—Annual convention, Chicago, Ill. Secretary, H. W. Dodd, 261 Broadway, New York, N. Y.

Jan. 17-20, 1922—American Road Builders' Association—Nineteenth Annual Convention, Twelfth American Good Roads Congress and Thirteenth Good Roads Show under the auspices of the A. R. B. A., The Coliseum, Chicago, Ill. Secretary E. L. Powers, 11 Waverly Place, New York, N. Y.

American Road Builders' Association

In view of the fact that road building now forms a very considerable proportion of the construction industry, which is said to be the second largest in the United States, particular interest attaches to the announcement from the American Road Builders' Association that its next annual convention and good roads show will be held at Chicago, Ill., on Jan. 17, 18, 19 and 20, 1922.

Last year the meeting and show, generally considered the most successful in the annals of the organization, were held at the Coliseum in Chicago. The location of that city is so central and convenient that the directors decided to go to Chicago again this year and plans are being made for a convention and show even greater than last year's.

In addition to sessions for the presentation of papers and the discussion of road building problems, the usual exhibition of road building machinery and materials will be held. During the past decade, road building methods have been revolutionized by the introduction of labor saving machinery. In 1919, the last year for which figures are available, more than $100,000,000 worth of road machinery was manufactured, according to the U. S. Department of Commerce. This is greater than the value of all other construction machinery produced in that year, and shows the relative importance of road building. Further evidence of the importance of that particular branch of construction lies in the fact that over $1,000,000,000 is available for highway work, with every prospect of legislation that will add materially to that amount.

Canadian Highway Association

The Canadian Highway Association was organized last month at Victoria, B. C., to promote the construction of a continuous highway across Canada. John L. Beckwith was elected president, and Samuel Hill, of Seattle, Wash., was chosen honorary president. The resolution nominating Mr. Hill described him as "an international citizen of the Pacific Northwest," and his selection as "a tribute to his indefatigable and splendid good roads work in the entire Pacific Northwest and as a mark of appreciation of his record as president of the Pacific Highway Association."

North Carolina Good Roads Association

The annual convention of the North Carolina Good Roads Association will be held on Oct. 10, 11 and 12 at the O'Henry Hotel, Greensboro, N. C. The tentative program has been prepared as follows:

A meeting of the Executive Committee will be held on the evening of Oct. 10 at the O'Henry Hotel. After the opening speeches on Oct. 11, the following papers and discussions are scheduled: "Taxation and the State Road Program," by H. G. Connor, Jr., and B. W. Parham; "The State Highway Law," by A. M. Scales, Heriot Clarkson and T. C. Bowie; "Realizing on Our State Highway System," by T. L. Kirkpatrick; "The Administration of the State Highway Commission Under the 1921 Law," by Frank Page, Chairman, State Highway Commission; "Location, Construction and Maintenance of the State System of Highways," by C. M. Upham, State Highway Engineer; "Selecting the State Highways," by John S. Hill; "Resort Development in North Carolina as a Result of the State Highway Program," by Hugh MacRae.

On Wednesday, Oct. 12, county highway problems will be discussed by county commissioners and engineers. In the afternoon Dr. Joseph Hyde Pratt will speak on "Safety First and Courtesy on the Highways" and Mrs. N. J. Rouse will speak on "Memorial Highways and Economic Value of Beautifying State Highways."

After the business meeting an automobile trip will be made over the roads of Guilford County. In the evening a smoker will be held in the ball room of the O'Henry Hotel.

Washington State Good Roads Association

The twenty-second annual convention of the Washington State Good Roads Association was held on Sept. 15 and 16 at Tacoma, Wash. Following the address of welcome by Mayor Riddell of Tacoma, E. C. Burlingame, President of the association, gave the response. In the afternoon of the first day the speakers included N. B. Coffman, of Chehalis; Miss Jeanne Caithness, of Colfax; C. L. MacKenzie, of Colfax, and State Highway Commissioner James Allen, who spoke upon the progress of road construction in the state.

The speakers on the second day included A. W. Eldridge, of Seattle; Senator F. J. Wilmer; Fred Wolf, of Newport; Herbert Culbert, of Seattle; Douglas A. Shelor, Manager of the Automobile Club of Western Washington, and C. A. Collins, Secretary of the Evergreen Highway Association.

Dixie Highway Association

The annual convention of the Dixie Highway Association was held in Cincinnati, O., on Sept. 9, 10 and 11 with an attendance of nearly 2,000 delegates, representing 11 states. Most of the delegates came to the convention in automobiles over the Dixie Highway. Motor caravans starting at the two extremities of the highway arrived in Cincinnati the night before the opening of the convention.

The Cincinnati Chamber of Commerce awarded a prize of $100 to M. A. Campbell, of Miami, Fla., as the representative who had traveled the greatest distance to attend the convention. Upon the completion of his return trip Mr. Campbell will have driven 2,304 mi.

Hamilton County, Tennessee, won a silver loving cup for having been represented by the largest delegation more remote than 100 mi. from Cincinnati. Grant County, Kentucky, carried away a like trophy for the largest delegation within 100 mi.

PERSONAL MENTION

Robert L. Ward has been appointed city engineer of Canon City, Colo.

S. E. Bradt has resigned as State Superintendent of Highways of Illinois.

J. Gresham has been appointed county engineer of Travis County, Texas.

E. F. Schlessinger has resigned as chief engineer of the Ohio State Department of Highways and Public Works.

Ben Blow, formerly manager of the Good Roads Bureau of the California State Automobile Association, has been appointed manager of the Victory Highway Association.

S. A. Knisely has been appointed economist by the National Paving Brick Manufacturers' Association. Mr. Knisely was formerly with the Cleveland "Plain Dealer."

L. S. Smith, Professor of Highway Engineering and City Planning at the University of Wisconsin, has been appointed engineer for the City Plan Commission of Appleton, Wis.

H. N. Roberts has been appointed city engineer of Atlanta, Tex.

D. L. Morgan, of New Haven, Conn., has been appointed chairman of the Executive Board of the American Automobile Association. Mr. Morgan was formerly in the candy business.

Clifford Richardson, Consulting Engineer to the Barber Asphalt Paving Co., will retire from active practise, leaving New York City to reside at Santa Barbara, Cal. Mr. Richardson has played an important part in the development of asphalt pavement to its present state of efficiency, devoting the past 30 years to the improvement of asphaltic materials and pavements.

◆

The New Jersey State Highway Department has awarded contracts covering all funds available for the present year.

A Bridge at Fairview, Ky., over the Cumberland River, collapsed recently, precipitating 26 persons into the river. None were injured seriously, since the stream is but 4 ft. deep at the point where the bridge failed.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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*Illustrated article

Concrete Roads must be reinforced

It is demonstrated beyond doubt that to make concrete roads proof against heavy motor traffic, weather and time a fabric of steel must be incorporated in the concrete.

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Maintaining a Busy New York Highway at Small Cost—

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Three views of the Grand Concourse and Boulevard, which give some idea of the heavy traffic over this thoroughfare.

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GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

WITH WHICH IS INCORPORATED

THE HIGHWAY CONTRACTOR AND ROAD BUILDER

Vol. LXI. NEW YORK, N. Y., SEPTEMBER 28, 1921 Number 13

Pacific Highway Peace Portal Dedicated

Citizens and Officials of Two Nations Meet at Canadian Boundary at Blaine, Washington, for Dedication of Portal on the Pacific Highway Commemorating the Completion of a Century of Peace between Great Britain and the United States

The massive concrete and steel Peace Portal on the Pacific Highway at the Canadian border, erected to commemorate the completion of more than a century of peace between Great Britain and the United States, was dedicated with impressive ceremonies on Monday and Tuesday, Sept. 5 and 6.

The portal stands partly in Canada and partly in the United States, in the center of a 125-ft. circular area in a 5-acre park. The American portion of the park was donated by the Town of Blaine, Wash., while the Canadian portion was the gift of the Province of British Columbia. The celebration on Sept. 5 was held at Victoria, B. C., while that on the following day was held at the portal.

The Peace Portal, shown in the illustration on the cover of this issue, is 54 ft. in height and rests upon a concrete and steel foundation supported on piles. Bronze doors, which had not been hung when the photograph reproduced on the cover was taken, are recessed into the walls. One of them bears the inscription, "Open for 100 Years," while the other carries the words, "May These Doors Never be Closed." At the top of the portal on the American side are the words, "Children of a Common Mother," and on the Canadian side in a corresponding position are the words, "Brethren Dwelling Together in Unity."

SAMUEL HILL AND FRANK TERRACE AT THE PACIFIC HIGHWAY PEACE PORTAL, BLAINE, WASH.

The ceremonies on the 5th were held at the Parliament buildings at Victoria, among those taking part being Lieutenant Governor Walter Nichol, of British Columbia, who presided; Premier John Oliver, of British Columbia; A. E. Todd, of Victoria, "Father of the Pacific Highway"; Samuel Hill, of Seattle, originator of the Peace Portal plans; and Frank Terrace, of Seattle, one of Mr. Hill's able associates in good roads work in the Northwest.

On the 6th the official visitors were carried to Blaine by yachts from various clubs in neighboring cities. One of the features of the ceremony was the depositing of relics from the Mayflower and the Beaver, the latter the first steamer to enter the Pacific Ocean in receptacles in the portal. The Mayflower relic, a piece of wood about 20 in. long, was presented to the American Society of Friends by the British Society of Friends at Jordans, Buckinghamshire, England, last spring, and was brought to America by Mr. Hill. It was placed in a lead casket and placed in the portal on the American side. A similar casket containing a piece of timber from the Beaver was deposited in the structure on the Canadian side. Over the resting place of each relic is a bronze relief of the vessel from which it came. Both of these bronzes, not in place on the portal, are shown in the accompanying illustration.

The officials and others present at the dedication included Premier Oliver and Lieutenant Governor Nichol of British Columbia; Mayors R. H. Gale, of Vancouver, B. C., J. J. Johnson, of New Westminster, B. C., E. T. Mathes, of Bellingham, Wash., and Harold Hunter, of Blaine; Former Governor Oswald West, representing Oregon; Lieutenant Governor W. J. Coyle, representing Washington; Samuel Hill; and Frank Terrace.

In the course of his address, Mr. Hill said, in part:

"The ceremony in which we take part to-day marks the recognition of the oneness of the English speaking race and its friendship, not alone for the white race, but its earnest desire to be at peace with all the world. War satisfied neither the victors nor the vanquished.

"Perfect peace alone satisfies, and let me express the hope that, where science, the arts and religion have failed to control the passions of men, that still small voice that spoke to Socrates, Plato, Savanarola and the other wise men of old, will prevail."

One of the features of the dedicatory exercises was the completion of the film, "The Sacred Faith of a Scrap of Paper." Mr. Hill has had this film prepared to celebrate the unbroken peace between the United States and Great Britain, following the signing of the Treaty of Ghent on Dec. 24, 1814. It depicts scenes in the English barn in which the Mayflower relic was found, in the house in which the Treaty of Ghent was signed, and in Brussels and Paris. Among the famous personages appearing in it are Cardinal Mercier, Marshal Joffre, Burgomaster Adolphe Max, of Brussels, and his wife, and Prime Minister Henri Carton de Wiart, of Belgium, and his wife.

The proposal to erect a peace portal at Blaine was made at a joint flag raising held there under the auspices of the Pacific Highway Association on July 4, 1915, to celebrate the completion of a hundred years of peace between Canada and the United States. The idea is credited to Mr. Hill and it is chiefly due to his efforts that the project has been carried to completion. Work was started in 1920, the war having delayed carrying out the plans of the architect, H. W. Corbett.

The Pacific Highway, the history of which is so closely connected with that of the Peace Portal, extends from Vancouver, B. C., to Tia Juana, a town just across the Mexican border in Lower California. It traverses the States of Washington, Oregon and California, and is about 2,000 mi. long. It was proposed by A. E. Todd some twelve years ago and its construction has been promoted by the Pacific Highway Association, in which Mr. Hill has been very active. It is expected that the paving of the road will be practically completed by 1925.

In order to build the Peace Portal at the point where the highway crosses the international line it was necesary to obtain the consent of the Canadian Government and of the Government of the United States, the former requiring an act of Parliament and an order in council.

In speaking of the portal some time ago, Mr. Hill said:

"It is the first arch to be erected in the world to celebrate peace. Paris has the Arc de Triomphe, Berlin has the Brandenburg Thor; but in no place is there a memorial to peace."

Prevailing Unit Prices for Road Work

Comparative Cost Data Compiled from Highway Bids Received by Various States.

The Nebraska State Highway Department has compiled average unit prices on road work let this year in various states, as follows:

Nebraska

Clay surfacing, cu. yd.	$0.334
Loose rock excavation, cu. yd.	0.83
Solid rock excavation, cu. yd.	1.80
Concrete culvert headwalls, cu. yd.	36.24
Concrete box culverts, cu. yd.	32.56

Iowa

Earth excavation, cu. yd.	$0.4003
Concrete pavement, 8-in., sq. yd.	3.73
Concrete culverts, with reinforcement, cu. yd.	26.65

Illinois

Excavation, cu. yd.	$0.417
Borrow, cu. yd.	0.352
Excavation for paving, cu. yd.	0.621
Shoulders on concrete road, sq. yd.	0.080
Concrete pavement, sq. yd.	1.771*
Concrete drainage structures, Class A, cu. yd.	22.891*
Concrete drainage structures, Class B, cu. yd.	22.755*
Reinforcing steel, lb.	0.0504
Structural steel, lb.	0.0652

*Cement supplied by state.

Wisconsin

Earth excavation, cu. yd.	$0.748
Concrete road, mi., $32,475, sq. yd.	2.78
Concrete culverts, reinforced, cu. yd.	26.00

Kansas

Earth excavation, cu. yd.	$0.50
Concrete pavements, sq. yd.	3.09
Brick pavement, sq. yd.	3.80
Concrete headwalls, cu. yd.	35.00
Concrete box culverts, cu. yd.	20.99

South Dakota

Earth excavation, cu. yd.	$0.401
Concrete culvert headwalls, cu. yd.	30.387
Concrete culverts, cu. yd.	30.363

Wyoming

Earth excavation, cu. yd.	$0.30
Concrete pavement, 6-in., sq. yd.	2.75
Concrete headwalls, cu. yd.	28.00
Concrete box culverts, cu. yd.	30.00

(Concluded on page 165)

Federal Aid to States*

Provisions of the Federal Aid Act — Work Preliminary to Operation — Results of Federal Aid — Organization of Bureau of Public Roads — Administration of Federal Aid Act — Work Planned and Accomplished — Types of Roads — Maintenance — Plans for Future Activities

By P. ST. J. WILSON†

In July, 1916, what is known as the Federal Aid Road Act became a law.

For nearly a century previous to that time the Federal Government had taken practically no part in the improvement of the highways of the country. The object of the law was to stimulate the construction of roads through the agency of the state highway departments and not the construction of a federal system apart from the state and local roads.

The act placed an appropriation of $75,000,000 for the construction of rural post roads in the hands of the Secretary of Agriculture, which was made available in installments as follows: $5,000,000 the first year, $10,000,000 the second, $15,000,000 the third, $20,000,000 the fourth, and $25,000,000 for the fifth which is the current fiscal year. It also carried an appropriation of $10,000,000, available at the rate of $1,000,000 per year, for the construction of roads in the national forests. In February, 1919, soon after the signing of the Armistice, an additional appropriation of $200,000,000 was made by Congress. Of this appropriation, $50,000,000 became immediately available and $75,000,000 was available for the fiscal year 1920, and $75,000,000 for the fiscal year 1921. An additional $9,000,000, available at the rate of $3,000,000 per year, was appropriated for the construction of forest roads. The act authorized the expenditure of not to exceed 3% of the post road appropriation by the Secretary of Agriculture for administering the provisions of the act.

The post road appropriation is apportioned among the states on the basis of three factors—area, population and mileage of rural post roads, each factor having equal weight. Federal funds may be expended only for construction and must not exceed 50% of the cost of the road.

The original act limited the expenditure of Government funds to $10,000 per mile exclusive of bridges of more than 20 ft. clear span. By a subsequent act this limit of federal funds was increased to $20,000 per mile.

The act laid down three requirements with which the states were asked to comply before they could receive allotments of federal aid. First, the state legislatures should assent to the provisions of the act, or the governors of those states in which the legislatures were not in session should assent pending the convening of the legislatures; second, each state should have a state highway department and these departments should have direct supervision over the construction on which these federal funds were to be expended; third, federal funds should be met by at least an equal amount of state funds. In some states the state highway departments had to rely on the counties for these funds as there were no state funds available, and in several instances, there was constitutional prohibition against states expending money on internal improvements. However, as the federal law required the Secretary of Agriculture to deal only with the state highway department, the county funds had to be placed at the disposal of the state highway department.

The Secretary of Agriculture delegated the duty of caring for the details of the administration of the act to the Bureau of Public Roads. The fact that the Bureau of Public Roads was already in existence, and at the time of the passage of this act in close touch with the highway situation and the requirements of the country as a whole, made it possible to begin operations immediately.

An immense amount of preliminary work was necessary before the terms of the act itself could be put into operation. First, the Secretary of Agriculture was required to apportion the federal funds for the first fiscal year and to establish rules and regulations. In the preparation of these regulations it was necessary that the views of the several state highway departments should be carefully considered. The act was passed on July 11, 1916, and on July 21, 1916, the certificate of apportionment of funds for the first year was issued. The rules and regulations, prepared after a conference with the state highway officials, were issued Sept., 1916. It was also necessary to ascertain which of the states were equipped with highway departments within the meaning of the act and to await the assent of the state legislatures to the provisions of the act, or of the governors whose state legislatures were not in session. These and other necessary preliminaries, such as the making of plans, etc., prevented any actual construction work being done prior to 1917.

At the outset the Secretary of Agriculture requested the states to furnish maps showing definite systems of roads for the construction of which federal aid would be asked. These systems, involving about 214,000 mi. of road or about 8% of the total 2,500,000 mi. of roads in the United States, were filed and except in about 5% of the projects where the desirability of revision has since been apparent, the apportionment of federal aid has been expended upon parts of these systems.

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* Paper presented at the annual meeting of the Michigan State Good Roads Association, Flint, Mich., Aug. 30-Sept. 1, 1921.

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The work had hardly begun when war was declared with Germany on April 6, 1917, and from that time to the signing of the Armistice all energies of the nation were directed toward the interests of war. Other interests were subordinated to that end and federal aid road construction was curtailed wherever possible to release men and materials for that all important purpose.

In spite of the delays incident to the prosecution of the work, in the face of strikes which have crippled the transportation systems of the country and reduced the output of necessary materials of construction to a degree unprecedented in the history of the nation, the program of cooperative highway construction laid down in 1916 has been adhered to and the results which have been obtained thus far stamp the plan as an unqualified success, although, of course, the results have not been as great as they would have been under normal conditions.

One of the earliest and most far-reaching results directly traceable to the act was the creation of adequate highway departments in 17 states which previously had either no state highway departments at all or which had departments insufficiently equipped to perform the necessary functions. In one year after the passage of the act more constructive highway legislation was placed upon the statute books than had ever before been enacted in the history of the country in a similar period, and a condition was brought about which otherwise could not have been reached in a decade. This legislative activity was the direct consequence of the condition imposed upon the states by the Federal Aid Road Act. The insistence of the Government upon the construction of federal aid roads under the supervision of the engineers of the state highway departments has resulted in the placing of more and more road work in the country under skilled supervision.

In 1915, the year before the Federal Aid Road Act was passed, only 30% of the expenditures for roads and bridges built in the United States was expended under the supervision of state highway departments. This year the state highway departments have exercised control over fully 80% of the large sums which have been spent for road construction. In 1915 the total expenditures for roads and bridges by all of the state and local governments was $267,000,000. This year it is estimated that the funds available for main road and bridge construction amount to $622,000,000. The willingness of the public to appropriate these greatly increased sums is largely due to the confidence which has been inspired by the creation and strengthening of the state highway departments, the immediate cause of which was the Federal Aid Road Act.

The organization under the chief of the Bureau of Public Roads which cares for the details of the administration of federal aid funds consists of a headquarters force headed by the chief engineer in the Washington office, and 13 district engineers in charge of the work in 13 groups of states. The district engineers are assisted by a number of engineers who have supervision over sections of the district work. Where the work is sufficiently heavy to warrant it, one or more resident engineers have been placed in a state. In other districts men are assigned by the district engineer to cover special states, but do not have headquarters in those states. These men are authorized to approve slight changes in plans which become necessary as the work progresses, such as changes in the size of waterways, locations of culverts, slight changes in grade and alignment, and even more important changes, provided they do not involve the Government in additional expense. By thus making it possible to effect minor engineering adjustments on the ground, a great deal of time is saved.

The Federal Aid Act requires that projects for federal aid be initiated by the states. As the first step, a statement is forwarded to the district engineer in authority, announcing, in effect, that the state proposes to build a piece of road of a certain type and length in a certain location. If, in his opinion, it seems satisfactory, the statement is forwarded to the Washington office with his recommendation. It is there examined by the chief engineer and his assistants, and, if the chief engineer concurs in the recommendation of the district engineer, the project is placed before the Secretary of Agriculture by the chief of the bureau, with the recommendation of the bureau, for the Secretary's approval.

If the Secretary approves, the state is so notified, and it then proceeds to prepare detailed plans, specifications and estimates for the work.

After the Secretary has given the preliminary aproval, the state submits plans, specifications and detailed estimates for work to the district engineer, who after a review of the plans and inspection of the site of proposed work, makes his recommendation to Washington. As soon as the district engineer has recommended the plans and specifications for approval the state may advertise for bids and let the contract.

Up to July 31, 1921, 4,504 projects, involving a total of 35,402 mi. of road, had been approved by the Secretary of Agriculture. The preliminary estimate of the cost of these projects is $579,293,693, of which $247,956,457 will be federal aid. There have been completed or are now under construction 25,729 mi. of road, the total estimated cost of which is $440,258,301 and the amount of federal aid involved is $188,-

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GOOD ROADS
CONSTRUCTION TRANSPORTATION MAINTENANCE

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Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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FIVE YEARS OF FEDERAL AID

It is a little more than five years since federal aid was established. During the entire time conditions have been unfavorable to progress because of the Great War and its aftermath. For about a year and a half all the energies of this country were bent to the winning of the war and since the Armistice there have been labor and material shortages, strikes, transportation difficulties and other hindrances to the prosecution of the work of building roads.

In spite of all this, the results of the participation of the Federal Government in road work have been good enough to "stamp the plan as an unqualified success," according to Chief Engineer P. St. J. Wilson of the U. S. Bureau of Public Roads, whose paper at the recent meeting of the Michigan State Good Roads Association is printed on other pages of this issue.

Under the Federal Aid Act there has become available to the states a total of $275,000,000, not including $19,000,000 appropriated for forest roads. Up to July 31 of this year, the Secretary of Agriculture had approved federal aid projects calling for $247,956,457 of this—or practically 92% of the total. Work completed to that date involved federal funds to the amount of $128,135,526, while some $60,000,000 more is involved in work under way.

This is a good showing, especially in view of the handicaps under which road builders have labored. The chief thing to note, however, is not what has been done but what remains to be done. The Government's appropriations are used up. Immediate action on further appropriations is the urgent need now.

England is Also Unappreciative Engineering services command respect and compensation as far from commensurate with their worth in England as in the United States, according to recent editorial comment in "The Surveyor," an English engineering periodical. What a local authority wants for its money—in this case about $1,500 a year—is set forth on other pages of this issue under the caption, "Salaries Again."

Maryland to Mark Roads Some weeks ago note was made of plans for marking roads in North Carolina. Similar work is being done by the Maryland authorities on an ambitious scale. Not only will there be the usual direction and warning signs, but at the limits of large towns there will be maps showing the principal routes through the towns; at tops of grades in the mountains there will be special directions for negotiating the road ahead; and at the state line there will be boards carrying a brief summary of the salient points of the state motor vehicle laws.

Early Road Location Dr. P. E. Doolittle, President of the Canadian Automobile Association, paid his respects to the pioneer road builders of America, in the course of a paper at the recent meeting of the Michigan State Good Roads Association, as follows: "In your own country the history of your early roads is not familiar to me, but judging from some of the detours we took with the recent Pikes Tour over the top route, I would imagine that they at least had been laid out by a drunken Indian with a cross-eyed dog chasing a three-legged rabbit." A drive over old roads in almost any part of the country would lead one to a similar conclusion.

Philippine Chauffeurs Obtaining honest, conscientious operators was characterized some time ago by an authority on motor transport as one of the chief difficulties to be overcome in making a success of the business of hauling merchandise by truck. Experience in the Philippine Islands has borne out this contention, according to an item appearing elsewhere in this issue. When motor truck transportation was first employed, the native drivers caused considerable difficulty by their persistent retention of a considerable proportion of the transportation charges. The difficulty was overcome by an ingenious appeal to the native love of gambling. Readers will have to point their own morals.

California Offers Highway Bonds

The State of California will sell $5,000,000 of state highway bonds bearing 5¾% interest on Oct. 27. A similar amount of road bonds bearing the same interest was recently sold by the state.

Highway Officials Want More Money

At a meeting of the Connecticut State Board of Finance on Sept. 13, Charles J. Bennett, State Highway Commissioner, recommended the following salary increases: Deputy Commissioner Richard L. Saunders, from $4,500 to $5,000; W. L. Ulrich, Superintendent of Repairs, from $4,500 to $5,000, and Clinton G. Nichols, Chief Clerk, from $4,000 to $4,500.

Freight Rate Cuts Do Little Good

Reductions in freight rates on sand, gravel and crushed stone, authorized by the Interstate Commerce Commission for railroads in the eastern trunk line territory "come too late to stimulate building and construction work for this year," according to a statement issued by the National Association of Sand and Gravel Producers. "Contracts for road work have been let and sufficient time is not allowed before cold weather sets in to start new building projects."

New York Will Hold Fall Lettings

State Unable to Let All Work in Fall Because Funds Are not Available Until Spring

Relative to the letting of road contracts in the fall of the year, H. S. Sisson, State Highway Commissioner of New York, has made the following statement:

"I am entirely in sympathy with the movement fostered by the Associated General Contractors and other business interests to award highway contracts in September and October instead of in the spring months. However, owing to the conditions which confront this department, especially as to appropriations to be made by the Legislature, it will be impossible for us to award more than 50% of the highway work that we expect to put under contract during the season of 1922 before April or May of that year.

"Appropriation bills are rarely passed before March 1 and at least 50% of the highway construction to be undertaken next year must await the action of the Legislature in providing money to cover the cost of the construction contemplated.

"We shall use every effort in this department to award as many contracts in the fall and winter as possisble, and to prepare plans for the remainder so that as soon as the appropriations are made and details attended to, we may award the contracts as early in the spring as possible.

"The first of the fall awarding of contracts will be held on Sept. 30."

Eight Bridges in Philadelphia Are Reported Dangerous

Following the recent bridge disaster at Chester, Pa., in which 24 persons were killed, the bridges of the City of Philadelphia, Pa., were inspected by the Bureau of Surveys. The report of the bureau states that at least eight bridges are in dangerous conditions and should be replaced by new structures.

War Department Rejects Damage Claim

Payment of $400,000 damages claimed by Burlington County, New Jersey, arising from alleged destruction of roads by Army trucks has been refused by the War Department, according to J. M. Wainwright, Assistant Secretary of War.

In answering the claim of Burlington County, Mr. Wainwright stated that the highways are established and dedicated to public use, and that there can be no question that the United States Government is entitled at all times to the free and uncontrolled use of the highways to as great an extent as private corporations or individuals.

Road Work in New York

Since February the New York State Highway Department has awarded 143 contracts for the construction of 562 mi. of road at a cost of $24,500,000. During the same period the department has accepted 166 mi. of completed highways. At the present time 196 contracts are in force, employing nearly 10,000 men.

Of the highways under contract 90% of the work on 42 roads has been finished, 50% on 117 and 75% on the remainder. Projects in the nine divisions are being pushed as rapidly as possible and it is probable that 500 mi. of highways will be completed before the close of the season.

Locating Engineer Slips on Track

Engineers in charge of the construction of a state road near Port Carbon, Pa., find themselves in a situation similar to that of a man who built a motor boat in his cellar and had to move the house to get the boat out.

After building about a mile of concrete road at a cost of about $30,000, it has been discovered, according to reports, that the Philadelphia and Reading Railway tracks are so high above the road that a bridge to cross them would cost an immense sum of money. The road can not be laid under the tracks because the Schuylkill River is near and the road would be below the level of the river. For this reason the state officials are considering abandoning the road and building a new road through Palo Alto.

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The Governor of Texas recently signed a bill reducing the salary of the state highway engineer from $10,000 to $9,000 a year.

Prevailing Unit Prices for Road Work

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Mississippi

Earth excavation, cu. yd.	$0.22
Concrete pavement, sq. yd.	$3.15— 2.64
Concrete culvert headwalls, cu. yd.	20.00—25.00
Concrete box culverts, cu. yd.	22.50—30.00

Montana

Common excavation, cu. yd.	$0.44
Intermediate excavation, cu. yd.	0.76
Rock excavation, cu. yd.	1.54
Concrete headwalls, cu. yd.	25.33
Concrete box culverts, cu. yd.	27.02

Oregon

Common excavation, cu. yd.	$0.744
Bituminous pavement, 5-in., sq. yd.	2.686
Concrete headwalls, cu. yd.	26.15
Concrete box culverts, cu. yd.	29.50

Kentucky

Earth excavation, cu. yd.	$0.725
Earth excavation for paving, cu. yd.	1.00

Louisiana

Earth excavation, cu. yd.	$0.30
Concrete headwalls, cu. yd.	22.50
Concrete box culverts, reinforced, cu. yd.	27.50
Concrete bridges, reinforced, cu. yd.	33.50

Washington

Common excavation, cu. yd.	$0.44
Loose rock excavation, cu. yd.	0.85
Solid rock excavation, cu. yd.	1.49
Concrete headwalls, cu. yd.	26.36
Concrete box culverts, cu. yd.	25.84
Concrete bridges, cu. yd.	24.45

"Salaries Again"

This week our attention has been called to yet another example of the extraordinary requirements of a local authority desirous of obtaining the services of a qualified surveyor. The person appointed in this case will hold the offices of surveyor, inspector of nuisances, inspector under the Housing Acts, Factory and Workshop Acts, Petroleum Acts, etc., and he is required to possess full qualifications and to have had practical experience with regard to (inter alia) public water supply and duties under the Dairies, Cowsheds and Milkshops Order! So great are the attractions of this polytechnical job that it is actually being disposed of by tender, candidates being invited to "state the salary they require." But in order to keep candidates within bounds, the bidding is to start at £300 a year. The carefulness of the council does not end here, however, for among the many questions which every applicant is required to answer is one which asks whether he has "ever been bankrupt or executed an assignment or compounded with his creditors." Seriously, appointments of this kind are in the nature of a public scandal, and the time is more than ripe for some action by the Ministry of Health. To fill appointments in this way is really to put a premium on incompetence.—*The Surveyor and Municipal and County Engineer. (London.)*

Highway Fellowships at Michigan

The University of Michigan on Nov. 1 will award three fellowships in highway engineering and one in highway transport. These fellowships pays $300 each and lead to the degree of Master of Science. Fellows must be in residence from October to February or from December to March. Further information may be secured from Arthur H. Blanchard, Professor of Highway Engineering and Highway Transport, University of Michigan, Ann Arbor, Mich.

Motor Buses in the Philippines

Motor buses are playing an important part in the development of the Philippines and are changing the commercial life of the islands. Because of the lack of railroads, most labor was devoted to the production of commodities for local consumption, the difficulties of transportation being too great in most cases to overcome. Now the natives in many places can hail a motor bus and take their loads of hemp or copra to market many miles away.

At first considerable difficulty was experienced in operating bus lines because the native chauffeurs often retained a considerable part of the receipts. Several schemes were tried out and the one found most successful is on the lottery plan. The tickets are issued in duplicate and the patron holding the duplicate of the slip drawn each month wins the prize. If the ticket is not correctly punched as to distance traveled and weight of baggage the winner would forfeit the prize; hence the patrons demand honesty on the part of the chauffeurs.

Iowa Making 1921 Record Road Year

Early Start and Absence of Transportation Delays Assure Completion of Work that Will Make a Record for the State

Road builders got away to an unusually early start by the opening up of spring conditions two or three weeks earlier than usual. Dirt moving began in March in the southern part of the state and there has been no let-up. Paving men, in the southern part of the state chiefly, had their crews and equipment lined up ready to go, and made the jump-off and were under way before the end of April. Rainy weather conditions checked the work in the north at various times, but the heart breaking delays of last year, waiting for materials, were almost entirely absent. Now, in the middle of the season, with probably between 400 and 500 contractors and road building crews of all kinds going as fast as they can on the season's home stretch, there is no question whatever as to the record of the year surpassing any year Iowa has ever known. With the good start

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Federal Aid to States

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483,364. This work is 68% completed. The total cost to the Federal Government for the work done to date is, therefore, $128,135,526.

The projects which have been placed under construction since the signing of the Armistice involve an expenditure of approximately $421,000,000, while those which had been undertaken prior to that time involve only $18,850,000; that is, the actual construction which has been undertaken since the cessation of hostilities is 22 times as great as that which had been initiated in the 2¼ years prior to that time. This increase has been in the face of the worst economic conditions which have been experienced in a century and in spite of railroad strikes, inadequate transportation facilities and shortage of materials and labor.

The law requires that any construction undertaken under the cooperative plan shall be "substantial in character". Further than this the determination as to the type of the selected roads is left to the joint decision of the Secretary of Agriculture and the state highway departments.

In interpreting the word "substantial" the Secretary has taken cognizance of the fact that an improvement which is substantial for one density and kind of traffic may not be substantial for another. It has been recognized that the types of roads which it is desirable to construct in New York, Massachusetts, and Pennsylvania are not suitable or necessary for Nevada, Idaho and the Dakotas.

The fact that the former groups of states have a density of population of from 170 to 400 people per square mile, while the latter have from less than 10 to less than 1, is sufficient to indicate that the road type requirements of the two groups are far from identical. Such a conclusion is reinforced by an examination of the number of automobiles and motor trucks owned and operated in the several states in relation to the mileage of their roads. Thus in the states of Alabama, Arkansas, Nevada, South Dakota, and Oklahoma, the number of motor vehicles owned and operated is only 1 per mile of road, while in California there are 8 per mile, in Massachusetts there are 13 per mile, in New Jersey 13, and in Rhode Island 21. Recognizing these facts, the decision as to the type of road which the Secretary will approve for a given locality has been based in every case upon the traffic which is using the existing road and which it is estimated will use the improved road.

The natural conditions obtaining in the several sections of the United States are so diverse that an attempt to fit a uniform type of road of uniform construction as to depth of surfacing or width of right of way would result in over-improvement in one section and perhaps under-improvement in another. By this it is not meant to infer that no effort has been made to effect standardization of practices and methods where standardization is practicable. On the contrary, as early as April 28, 1917, standards governing the form and arrangement of plans, specifications, and estimates for federal aid projects were adopted and issued, and all states have since been working in absolute conformity to these standards in submitting federal aid projects. Indeed, they are making use of these standards in connection with work in which the Federal Government does not participate. Forty-five of the 48 states have submitted standard detail specifications for road construction, which they use for state work as well as federal aid work. The other three states still prepare specifications for each individual project.

In deciding upon the adequacy of plans proposed for particular federal aid projects the determination as to the type of road which will be constructed, as well as to the location, width, and other matters, is based upon an ascertainment of the facts in the particular case, which is as complete as it may be made. Such decisions must be mutually acceptable to the state highway departments, which look to the intersts of the states, and to the Secretary of Agriculture, who acts for the Government. The result is that the Secretary has approved roads of all types and widths, from graded earth roads to concrete, brick, or bituminous concrete, narrow as well as wide; but the essential point is that in each case the decision has been based upon the best engineering judgment of the Federal Government and the several state highway departments, which between them employ the most highly capable highway engineers in the country.

Low type, consisting of earth, sand-clay and gravel	32%
Intermediate types, water-bound to bituminous macadam	8%
High types, bituminous concrete, cement concrete, brick, etc.	50%
Miscellaneous	4%
Bridges	6%

Up to July 31, 1921, the apportionment of funds to the various types of road is shown as follows:

From which it will be seen that the larger percentage of federal aid is now being applied to high type construction.

A large part of the mileage of low type road which has been approved is in sections of the country where the pioneering work required to open up new territory yet remains to be done, or on projects which it is intended at a later date to surface with a more durable material. Each project agreement, in the case of an earth road, carries a provision that the state will construct a more durable surface when the demands of traffic require it.

As stated before, the Federal Aid Act, authorizes the expenditure of federal funds for construction only. It, however, provides that the states shall

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Crusher Run

Road building in the Empire State is going on at a more rapid rate than ever before, according to Commissioner Sisson's annual report. Since the present administration assumed charge last February, 143 contracts have been awarded. These call for the construction of 562 mi. of highways at a total cost of about $24,500,000. Work completed on the roads under contract amounts to 90% on 43, 30% on 119 and 70% on the remainder. It is intended to hold lettings during October and November.

The Brockway Motor Truck Co., an associate member of the New York State Road Builders' Association, is to erect a branch factory and service station at Albany.

One hundred and sixteen bids on 16 contracts were submitted at the letting held on Aug. 16, the work involving the construction or reconstruction of 58.22 mi. of state highways. Twelve bids were submitted on the Phoenix-Mexico, Part 3, Oswego County Road; 12 were submitted on the Grand Gorge—Breakabeen, Part 4, Schoharie County Road, and 14 were submitted on the Port Jefferson—Riverhead, Part 3, Suffolk County Road.

The contract for the Grand Gorge—Breakabeen Road, 4.39 mi., was awarded to Arthur F. McConville, Ogdensburg, at his bid of $159,550.90.

The Greenfield Construction Co., Hornell, was awarded the contract for the reconstruction of 1.34 mi. of road in Allegany County at $42,858.70, and Louis Mayerson, Albany, received a contract for the reconstruction of 4.51 mi. of road in Schenectady County for $77,218.50.

There was very spirited bidding at the letting held on Aug. 26 when 161 proposals were received for the work on 17 contracts for improvement and reconstruction. James H. Corbett, Jr., Baldwinsville, was lowest of 23 bidders on the Palmyra—Newark Road in Ontario and Wayne Counties, with a bid of $203,271.95 for 6.99 mi. of road. The highest bid, $255,850.20, was submitted by the Ribstein—Holter Co., Inc., Rochester. The engineer's estimate was $261,152.70.

The Hoosick—Hoosick Falls Road has been completed and formally opened by Commissioner Sisson. This road had been in an almost impassable condition for several years. A contract for its improvement was awarded about three months ago and work has been rushed in order to have the road ready for use before the close of the season.

Commissioner Sisson has decided that a 16-ft. roadbed is too narrow for the $800,000 Storm King Highway and has ordered the pavement widened to 18-ft. over the entire length, with additional width at curves. There will be no change in the type of pavement laid, bituminous macadam being used as was planned.

An inspection trip over the highway was made recently by Commissioner Sisson, Deputy Commissioners Sarr and Hotchkiss, Assistant Engineer Huber, Auditor Platt, and Division Engineers Schermerhorn, Sturdevant, Hall, Ripley, Filkin, Acheson, Edwards, Smith and Brownell.

The construction of the Cherry Valley—Sharon Springs—Canajoharie Road, 10.58 mi. long, will be one of the most important projects of Commissioner Sisson's administration. The contract for the work has been awarded to Michael H. Ripton of Rochester. First Deputy Commissioner Sarr has prepared a map showing the condition of the road up to June 25 of this year. On the back of the map are listed 122 points of interest.

Failure to hold any letting during September—the first month this year in which no lettings have been held—was due to delay in acquiring rights of way for several new roads. Sept. 30 had been designated for the September lettings, but it is expected that bids for the work involved will be received early in October.

EQUIPMENT--TRADE--MATERIALS

Highway Lighting

By H. H. Ashinger *

The enormous increase in the use of the highways for long-distance automobile and motor truck traffic and the ever increasing number of accidents at night bring out the importance of the proper lighting of roads by some means other than the blinding and dazzling headlights of the vehicles themselves. Considerable attention has been devoted to the control of glare from automobile headlights by means of specially designed lenses and shields, but it is believed that the desired results can be obtained only by means of independent lighting units mounted along the highway.

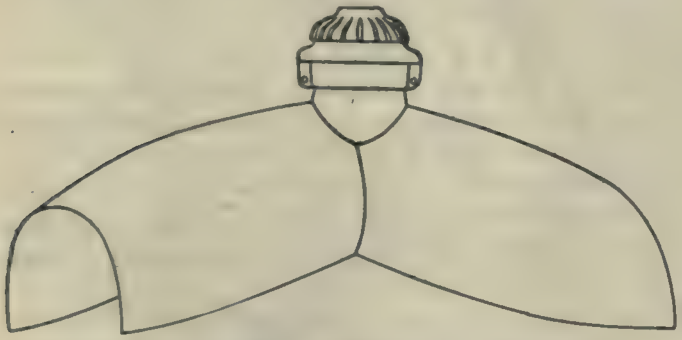

FIG. 1.—NEW TYPE REFLECTOR

The proper lighting of highways is accomplished by fulfilling at least two equally important conditions:

1—A clear view of the whole roadway for a considerable distance ahead of the car.

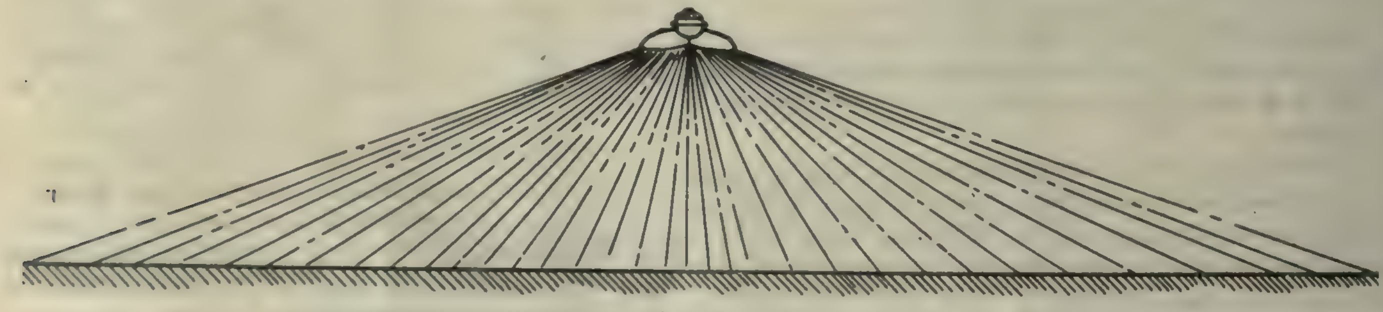

FIG. 2.—DISTRIBUTION OF LIGHT IN PLANE PARALLEL TO AXIS OF ROAD

2—The absence of glaring lights within the range of vision of the driver.

With the present high speed of travel on hard-surfaced roads, a well lighted roadway far in advance of the car is essential in order that the driver may be able to discern obstacles of any nature in time to avoid accident. Sufficient light on either side is also desirable for lighting marking signs, fences, ditches, and other objects not in the direct path of the car. The importance of the first condition has led to the extensive use of high power headlights and adjustable searchlights, and these devices are absolutely essential until a more satisfactory system of lighting the road is provided. As a matter of fact, they would accomplish the desired results if all traffic were moving in one direction. As this is seldom, if ever, the case, however, their use entirely defeats the second condition.

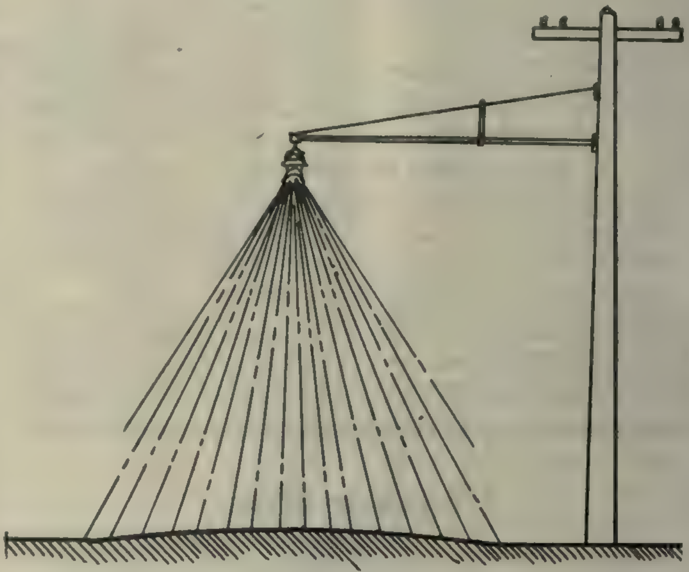

FIG. 3.—DISTRIBUTION OF LIGHT ACROSS ROAD

Any bare light source directly within the driver's range of vision, even though a considerable distance ahead or of low intensity, decreases his acuity of vision to such an extent that the possibility of accident is materially increased. In fact, the majority of serious road accidents at night can be charged (since the passage of the eighteenth amendment) to too much improperly directed light. The practice of dimming the headlights in passing cars is becoming universal, but it does not entirely relieve the trouble. Ordinarily, the dimmed headlight does not give sufficient intensity to properly light the road at a time when good light is of supreme importance.

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* Illuminating Section, Westinghouse Electric & Manufacturing Co., George Cutter Works, South Bend, Ind.

The lighting system that will fulfill the above conditions must necessarily contain some special features. Naturally, a most important factor in the system is the lighting unit, which must be specially designed for the purpose. A lighting unit recently designed by the Westinghouse Electric & Manufacturing Co., South Bend, Ind., has served to meet these exacting requirements. It consists, essentially, of a porcelain housing, which contains the series socket for a type "C" incandescent lamp, and a reflector. The unit is arranged for suspension from a series of interchangeable fittings, to be fastened to brackets, mast arms or span wires, as mounting conditions require. The reflector is made of steel, porcelain enameled, reflective white inside, with a bottle green enamel on the outside. Its shape is peculiar, being such as to throw the light on a long stretch of road without loss in the fields on either side. This unit, placed at the proper height above the road surface and spaced at proper intervals, will light the roadway at a fairly uniform intensity—a very desirable condition for the driver. Patches of light, like those under the ordinary steet lighting unit, at regular intervals, with darker stretches between them, are very tiresome and injurious to a driver's eyes when traveling over long stretches of road at a fair rate of speed. The effect upon the eyes is the same as that from a slowly flickering light to which the pupils of the eyes are continually laboring to adjust themselves. Another important feature of this unit is the angle of cut-off, which eliminates glare. Practical mounting heights do not permit the unit to be placed above the driver's range of vision, so it is very important that his eyes be shielded from high intensity of the light from the lamp. This is accomplished by shaping the edge of the reflector so that the light, in a line parallel to the direction of travel, is cut off through an angle of 14 deg. below the horizontal—the angle which has been determined by exhaustive tests to be the most practical.

Reflections from the polished road surface are just as disturbing to the eyes as direct light from the lighting unit itself. It is noteworthy that this reflector cuts off all light rays which would otherwise be reflected direct to the driver's eyes from the road surface or from the mirage-like mirror so often appearing just above the road surface during the summer season.

The distribution of power to the lighting units is of importance, but will require no apparatus other than that now in use for long distance lighting circuits. The pole mounting, moving coil regulator, for series lighting circuits, recently placed on the market, no doubt will be universally used in highway lighting because of its adaptability to this class of service.

Novel Method of Cleaning Sand

Excess Silt in Dry Sand in California Blown Out by Centrifugal Air Blower

A new method for treating a local sand to make it conform to the specifications for a concrete road has been adopted by the engineers of the Bureau of Public Roads in charge of California Federal Aid Project No. 41. Near the south end of the project no local sand could be found that conformed to the requirements of the specifications approved by the Bureau of Public Roads. These prescribed that the sand should contain not more than 5% of material which would pass a 100-mesh screen. The local sand analyzed about 15 to 20%, which was entirely too high to permit its use.

Instead of falling back upon the importation of suitable sand from another locality, the engineers devised a plant for blowing the fine particles from the sand. This district is extremely arid and in the summer the temperature mounts sometimes to 120°. in the shade, so that the sand is very dry when worked. The device used consists of an ordinary conveyor which lifts the sand to a revolving screen. Material which will pass a ¼-in. screen is discharged into a hopper under the screen and then through a narrow opening into a storage bin below. In falling from the hopper to the bin the sheet of sand passes directly in front of a nozzle which directs against the sand a current of air from a centrifugal air blower. By means of a pressure regulator at the blower the velocity of the air at the nozzle can be so controlled as to blow from the falling sand any desired percentage of the finer material.

The blower is operated by a belt from the same gas engine which operates the conveyor and revolving screen. The whole device is compact and inexpensive and the result is a satisfactory sand obtained at less cost than by any other method. The success of the plan depends, of course, on the dryness of the sand.

Iowa Making 1921 Record Road Year

(Concluded from page 165)

made last year, Iowans at the end of this season can begin to "point with pride" at a very satisfactory record of accomplishment.

During the month of July every working day saw more than a mile of pavement, two miles of gravel and five miles of permanent earth road grading completed. For several months expenditures in payment for all this work has passed the million a month mark and since the entire organization has straightened out on the last leg of the journey to the season's home goal, expenditures have been hovering between the million and three-quarters and the two million mark It certainly is a great road building year for Iowa.—*"Service Bulletin," of the Iowa State Highway Commission.*

MEETINGS

Calendar of Coming Meetings

Oct. 10-12.—North Carolina Good Roads Association.—Annual convention, Greensboro, N. C. Secretary, H. M. Berry, Chapel Hill, N. C.

Oct. 12-14.—League of Kansas Municipalities.—Annual convention, Lawrence, Kan. Secretary, John G. Stutz, University of Kansas, Lawrence, Kan.

Oct. 20-21.—Ohio State Conference on City Planning.—Annual conference, Columbus, O. Secretary, Charlotte Rumbold, Cleveland, O.

Oct. 20-21—Engineers' Club of Philadelphia.—Conference on City Paving. H. E. Hopkins, Secretary, 1317 Spruce St., Philadelphia, Pa.

Oct. 24-28.—American Society for Municipal Improvements—Annual Convention, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Nov. 14-16.—City Managers' Association.—Annual convention, Chicago, Ill. Secretary, H. G. Otis, City Manager, Clarksburg, W. Va.

Nov. 16-18.—National Municipal League.—Annual convention, Chicago, Ill. Secretary, H. W. Dood, 261 Broadway, New York, N. Y.

Jan. 17-20, 1922.—American Road Builders' Association.—Nineteenth Annual Convention, Twelfth American Good Roads Congress and Thirteenth Good Roads Show under the auspices of the A. R. B. A., The Coliseum, Chicago, Ill. Secretary E. L. Powers, 11 Waverly Place, New York, N. Y.

New Jersey Highway Contractors' Association

The annual meeting of the New Jersey Highway Contractors' Association was held on Sept. 10 at Belmar, N. J. In the morning a program of sports was carried out, followed by a clambake and shore dinner. In the afternoon a brief business meeting was held.

New England Road Officials

A conference of New England state highway officials will be held on Sept. 30 at Boston, Mass., to discuss the standardization of highway traffic regulations. The conference was called by the Massachusetts Safe Roads Federation. John N. Cole, Commissioner of Public Works of Massachusetts, will preside.

Western Society of Engineers

At a meeting of the Western Society of Engineers held on Sept. 12 in Chicago, Ill., A. R. Hirst, State Highway Engineer of Wisconsin, gave an address on "Developing a System of Highways to Serve the People of a State."

Allied Engineering Association

Among the papers to be presented this winter at the meetings of the Allied Engineering Association, with headquarters at Charleston, S. C., the following are of interest to road builders: Oct. 17, "The Auto Truck—Its Use in Road Work," by Lt. Col. Eugene Kelly; Feb. 20, "Concrete Roads," by James W. Martin; March 20, "Construction of Bridge Piers for the New Santee River Bridge," by J. B. La Bruce; May 15, "Paving of City Streets," by J. H. Dingle.

PERSONAL MENTION

Grover F. Clemens has been appointed chief engineer of the Ohio State Department of Highways and Public Works.

Virgil Cline has been appointed resident engineer by the Georgia State Highway Department in charge of work in Brooks County.

Frank T. Sheets, Engineer of Design with the Illinois Division of Highways, has succeeded S. E. Bradt as State Superintendent of Highways.

Federal Aid to States

(Concluded from page 166)

maintain the roads constructed with federal aid, or future federal aid shall be denied them until the roads are properly maintained.

While the roads already constructed and any which may be hereafter constructed are of greater importance to the states than to the National Government, since approximately 90% of the traffic is local in character, the Federal Government has an interest in the betterment of the main thoroughfares over which the remaining traffic passes. The development in recent years of the motor vehicle increases in importance the interstate highway. The Bureau of Public Roads, the Association of State Highway Officials, and the General Staff of the Army have been for some time in close cooperation in deciding upon a system of highways embodying a still smaller percentage of the total mileage in the United States which will best meet the needs of all classes of traffic and to which federal aid should be confined. Bills are now pending in Congress for continuation of appropriations of federal aid and making amendments to the present law which will accomplish the above object.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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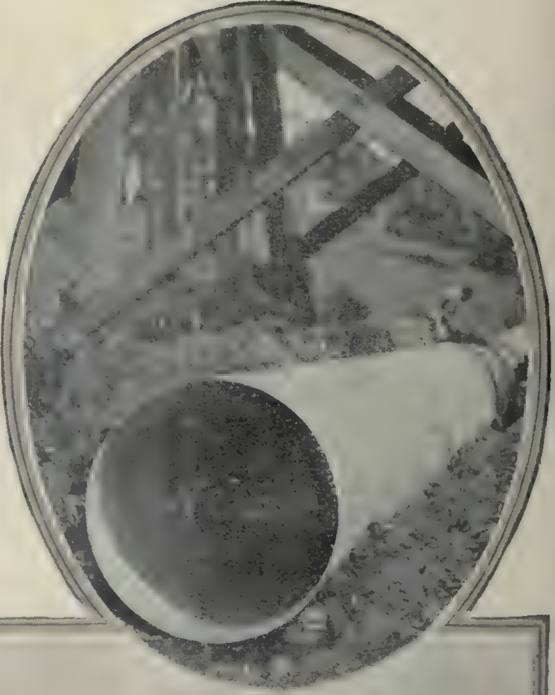

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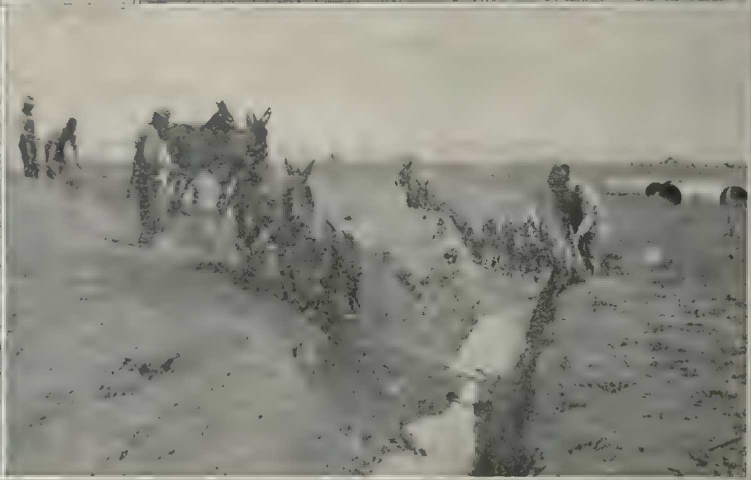

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GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

WITH WHICH IS INCORPORATED

THE HIGHWAY CONTRACTOR AND ROAD BUILDER

Vol. LXI. NEW YORK, N. Y., OCTOBER 5, 1921 Number 14

Roadside Development

General Provisions of Michigan Law—Public and Private Rights—Reasons for Beautification—Pole Lines and Encroachments—Planting and Trimming—Necessity for Skilled Workmanship, Study and Thorough Cooperation

By CHARLES F. BOEHLER†

BEAUTY AS WELL AS UTILITY is demanded of the modern road by a large and constantly growing proportion of its users. And the sporadic efforts to meet that demand that have marked road work in the past are giving way to a very general attempt to make roadside beautification an essential part of the road builder's labor. A brief account of recent planting legislation in Michigan and some general observations upon the problems incident to work of that kind are given in the accompanying paper.

At the extra session of the Legislature this year a bill was passed to place the trees and shrubs growing within the highway limits under the control of the authorities having jurisdiction over such highways. Through this act it was recognized that the public has an interest in the roadsides and, also, the authorities have been given new obligations to safeguard that public interest and new opportunities to complete the proper development of the highways.

Under this act the highway authorities are empowered to plant and care for trees and shrubs along the roadsides, under their jurisdiction and no trees or shrubs can lawfully be cut, trimmed or otherwise injured without the permission of such authorities. On state trunk line and federal aid roads this control is vested in the state Highway Commissioner and it is provided that the work shall be handled in cooperation with the counties on the same basis as trunk line maintenance.

This new law is not construed to take away from the owner of the abutting property all of his rights in the roadside trees, but rather to give to the highway authorities the right and duty to protect the public's interest in them. The trees along the roads add a great deal of attraction and value to the abutting property, both for sentimental and practical reasons.

ROADSIDE TREES—NATURAL ARRANGEMENT PRESERVED—OTTAWA COUNTY, MICH.

TREE PLANTING IN EMMET COUNTY, MICH.—MAPLE AND WHITE PINE—LATTER IN BACKGROUND

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* Paper presented at the annual meeting of the Michigan State Good Roads Association, Flint, Mich., Aug. 30-Sept. 1, 1921.

† Landscape Engineer, Michigan State Highway Department.

On the other hand they have an attraction in their shade and beauty to all those who use the roads. They add comfort and enjoyment to the public at large and have a beneficial effect upon the road surfaces. They become a part of the complete highway and the public has a distinct interest in them, the same as in the road surfaces. There is then a joint interest in the roaside trees, shared by the owner of the abutting property and the public at large. The trees cannot lawfully be cut nor injured without the consent of the highway authorities, but even with this consent the owner's interest should also be considered and his permission obtained before any trees are cut or trimmed. The consent of the highway authorities is required before the abutting property owner can lawfully cut or injure trees in the highways along his land—thus the public's interest is safeguarded.

Back of the legislation protecting the roadside trees and shrubs and providing for their planting there is a strong public sentiment for more beautiful highways. This has been evidenced by the large number of complaints received from the traveling public—which pay a large proportion of the cost of road improvement—whenever trees have been cut or improperly trimmed along the roadsides. It has been evidenced by the movement among local organizations in many cities toward the planting of trees to beautify the highways adjacent to those cities. It has been further evidenced by a movement to plant trees along the highways as a memorial to our soldiers, both living and dead. And for so small a cost what more fitting memorial could there be than the stately American elm, the majestic sugar maple and the sturdy oak growing at their best, as they do in Michigan? What would give enjoyment to so many people as trees and shrubs in proper arrangement along our highways?

The development of our roadsides is a problem whose solution is not simple, but it is one worthy of the careful study that its proper solution requires. Our highways serve more purposes than that of a means to travel. Public service corporations make use of them quite generally for the erection of telephone and power lines, while in certain localities trolley lines are partly or wholly within the highway limits. Service is demanded of these public utilities and when the lines are improperly placed with relation to the trees along the highways either the service must suffer or the trees must be trimmed. These public utilities then become a problem in our roadside development, but a problem which can ordinarily be solved without sacrificing the beauty of our highways. The more progressive public service corporations show a desire to cooperate with the highway authorities toward the saving of existing trees and providing for others along the roadsides. The highway authorities must cooperate with such corporations toward the same end. Through cooperation, an understanding on the part of the highway authorities of the needs of such service and an understanding on the part of such corporation of the public's interest in making and keeping the roadsides attractive, we can get results that will be of increasing enjoyment to ourselves and our children.

Another problem that has considerable bearing on the development of our roadsides is that of fences encroaching upon the highway. Most of our highways were laid out 66 ft. in width, but now we find that encroaching fences have narrowed many of them to much less, seriously interfering with the proper uses of the highways. Years ago when our main traveled roads had comparatively little traffic, when telephone and power lines were uncommon, and when a plentiful supply of existing trees gave no lack of roadside beauty, there may have been some reason for fences encroaching on the highways. But of late years conditions have entirely changed, traffic on the main roads has increased a thousand fold, telephone and power lines have become common, the diminishing beauty of the roadsides has awakened the people to a realization that they need that beauty and the necessity for the full width of the highway is becoming apparent. The boundaries of the highways should be fixed by suitable markers and as rapidly as practical all encroachments should be moved back to those lines, while no new encroachments should be permitted. If it is proper that telephone and power lines should be placed in the highways then it would be proper that the highway authorities should designate the location of such lines and it would become their duty to designgate such locations as would least interfere with the proper planting and protection of the trees that the law now provides for. The ideal location for telephone and power lines within the 66-ft. highway right of way would be at the extreme outer edges of the same and this location should be insisted upon wherever new lines are established or old lines changed unless such a location would more seriously affect existing trees. This would provide a space nearer the ditch lines for the growth of trees which, if properly placed and trimmed, would add beauty to the roadsides and would not interfere with service. In many places, however, on account of existing trees the poles should be placed close to the ditch lines, allowing space for trees outside of them. Each road is a study in itself but the full 66-ft. right of way should be available and the old tendency toward placing trees and poles in the same line should be abandoned.

There should be cooperation between all parties concerned, the highway authorities, the public service corporation, and the abutting property owners. And we, as highway authorities, should see to it that the highways are wide enough to provide for pole lines and roadside trees without interference with each other. With this cooperation, with the highways free from

(Concluded on page 178)

Useful Trees for Highway Planting*

Advantages of Nut Trees for Roadside Planting—Kinds Especially Adapted to Conditions in Michigan—Other Useful and Ornamental Varieties

By C. A. REED†

The discussion will be limited largely to the nut group, as the time allotted will preclude all possibility of adequately handling each of the species of both trees and shrubs which should be included under this broad heading. The nut group easily stands at the head of the list of plants now under consideration in the public mind for utility planting along the highways and in other unused places.

It is idle to parley over whether or not to plant trees along the highways. Roadside planting is here to stay and increase, despite the eloquence of those who argue that, with the burdens of the farmer already near the breaking point, he will not tolerate encroachment upon his land by roadside trees; that the product of the nut or fruit producing trees will be pilfered by city autoists, or bad boys; that such trees themselves will become public nuisances by being neglected and allowed to become breeding places for insect pests and fungi; that roadside trees are detrimental to the welfare of roads, etc., etc., ad infinitum.

Each of these arguments can at once be answered by admitting that we are perfectly aware of certain drawbacks. In fact, we regret the seriousness of some of them, yet, we repeat, that roadside planting of trees is here to stay and that it is going ahead while some of us argue. We also add that the solution of these difficulties will be found by those who plant and not by those who talk.

Granting that the planting of roadside trees has been decided upon, we maintain that for ornamental effect, size and grandeur of trees, rapidity of growth, longevity, resistance to both insect pests and destroying fungi, the nut group has representatives which are almost, if not quite, the equals of any American trees. The writer himself would make an exception in the case of the American Elm, which to his mind is a trifle the loveliest tree in all eastern North America. Asa Grey called it the Queen of the Forest. It has a wide range of distribution. It assumes wondrous beauty in early life and lives to great age. Under favorable environment it develops enormous proportions. A tree on Long Island recently discovered by the College of Forestry at Syracuse, New York, had a girth diameter, 6 ft. from the ground, of 31 ft. According to a New York City paper, this was the largest tree of any kind found in the state during a widely advertized contest. But, there are other kinds of trees almost as handsome as the elm, and which grow to great size and which produce a useful crop in addition to being decorative.

The New York paper which told of the giant elm stated that a black walnut, also on Long Island, was one of the four largest trees found during the contest. In the opinion of the writer, the black walnut is nowhere as common—as both a forest and a planted tree—as in Michigan. In the southern counties, with the cities of Grand Rapids and Bay City practically marking its northern limits of frequent occurrence, it is easily one of our most handsome growers. There is no other tree in the state of as great value for timber purposes. In congenial soils it is one of the most rapid growers of any hardwood. In August, 1920, while in a suburb of Boston, Mass., the writer had his attention called to a black walnut tree, then 6 ft. high, which had grown from a nut of the previous year's crop and which had dropped into the fertile soil of a flower bed.

The black walnut is a long-lived tree. To a considerable extent it has been used on roadsides for many years. Since the World War, it has quite properly been considerable of a favorite as a memorial tree, for which purpose it has qualifications equalled by no other species. It has taken active part in all our American wars but in none to the extent that it did in the war with Germany. The Forest Service of the United States Department of Agriculture at Washington is authority for the statement that it was used for gunstocks by practically all of the belligerent nations. Germany in particular, bought our logs for many years beforehand. Upon our own advent into the conflict, the need was suddenly so great that President Wilson issued a memorable call to the Boy Scouts of the United States to find and report the situation of walnut trees of merchantable size. Probably no other American tree ever was so vitally needed by the nation as the walnut was then. Walnut shells were used by the Gas Defence in the making of carbon for gas masks and no one knows the extent to which walnut kernels were included in the delicacies sent to our boys while in France. With a record of such valiant service, it would seem that wherever the black walnut will succeed, it should be planted as a memorial tree in preference to all others. Certainly we should take the precaution to plant now as an emergency measure for future wars, and there is no better place to plant it for any purpose than along the roadways.

One of the special advantages of the black walnut is the readiness with which it adapts itself to changed environment. In Northwestern Oregon where it is not native, it has been found to make fully as satisfactory an ornamental as it does back East. In Salem, on the home grounds of a sister of Hon. Charles L. McNary, U. S. Senator from Oregon, there stands a tree which when photographed one year ago challenged any other tree in the entire country ever seen by the writer for beauty and size at its age. It was then 51 years of age and had a girth diameter at breast height of 10 ft. 6 in. In the western outskirts of Howell, Livingston County, this state, on the north side of the road and on the southwest corner of a spacious lawn, there stands a tree which, while of no great proportions, illustrates the beauty and fitness of the species for either roadside or dooryard use.

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* Paper presented at the annual meeting of the Michigan State Good Roads Association, Flint, Mich., Aug. 30-Sept. 1, 1921.

† Nut Culturist, United States Department of Agriculture.

A question naturally arising in the minds of prospective planters of black walnut is when it will bear and how much it will produce. Some trees bear at early ages while others run 15 or 20 years before setting crops. Trees of selected varieties are now being propagated which often begin producing at truly reremarkably early ages. One of these varieties is the Ohio. In a nursery near Lancaster, Pa., a tree was once photographed which matured seven nuts the next year after having been grafted. The root of this tree was not more than three years old when grafted and consequently not over four years old when its grafted top bore the seven nuts. While such early fruitfulness is not wholly of advantage, as it is better for the tree to be six or seven years old from the time they are transplanted from the nursery before being allowed to fruit, it proves that the time of production is largely within the hands of the grower. Older trees are sometimes found which bear enormous crops. North and west of Hastings, a tree was once photogaphed when so heavily loaded with nuts that its branches bent over and broke to the ground. As there are differences in bearing habits of individual trees, so are there differences in the time of leafing out in spring and shedding foliage in fall, and in degrees of resistance or susceptibililty to insect pests and fungus diseases. Two trees in Lancaster County, Penn., were once photographed late in September when one was entirely denuded of foliage by fungus troubles and the other was still in fairly full leaf. Other walnut trees photographed at the same time were still in abundant summer verdure. These differences of individuality in trees must be taken into consideration when selecting seed for planting, if the best results are to be realized. A good rule to follow it to obtain seed from trees which in themselves possess as nearly as possible the desired qualities which it is wished to perpetuate, and from as nearly as possible the same locality.

The black walnut is far from being a stranger in public parks, private lawns or along public highways. In a suburb of Boston, Mass., it was found in such use on a private estate, although the owner frankly admitted that in his soil, without having made special selection of seed, he felt that some other species would have been more effective as an ornamental. In California, the highgway authorities are planting many miles of roadway with black walnut. In places there are already stretches of magnificent walnut trees along the roads of that state; one in particular borders the Lincoln Highway some 15 mi. west of Sacramento. In Livinggston County, this state, there are numerous rows of black walnut trees, upwards of 50 or 60 years old, which are among the beauty spots of its roadway system. Unfortunately few are on the trunk lines. Some 7 mi. southwest of Howell, to the west of what is known as the Stone Schoolhouse, stands the longest avenue of black walnut trees known to the writer in the East. Taking together the trees on both sides of the road there are somewhat over 125 trees in this pleasing avenue. That the black walnut is highly prized by some of the people of Michigan at least is emphasized by the labor of one of its distinguished citizens, Hon. W. S. Linton of Saginaw. Mr. Linton, who incidentally is president of the Northern Nut Growers' Association, last fall (1920) procured 30 bu. of selected walnuts from the home of George Washington at Mt. Vernon, Va., for distribution in his home state. These were largely planted by the school children along the roadways of Saginaw, on the school grounds and at their homes. About 2,000 were planted by Mr. Linton in a nursery for subsequent use in the city parks. These young trees are making splendid growth, due largely to the selection of soil by Mr. Linton and care of the trees taken by an engineer who has nothing to do with the outdoor park work but who has faithfully attended to these trees during his spare time. A considerable proportion of the trees are 2 ft. or more in height.

Some 15 or 16 years ago, when postmaster of Saginaw, Mr. Linton, planted a walnut in the ground in front of the Post Office building. Today the resulting tree stands as a beautiful monument of his handiwork and thoughtfulness at the time.

A species of walnut at times much advertised in the northern states and recommended for planting is the Persian, or more commonly called "English" walnut. It is a great commercial success in portions of California where the annual production is probably somewhat above 20,000,000 lb. To some extent in that state it is used along the roadways with pleasing effect, even in winter. However, it is capricious in its habits and east of the Rocky Mountains it is easily frozen in winter. There are one or two small orchards close to the lake in Sanilac County north of Port Huron, but except in peculiarily favored situations, it is of no practical value in Michigan.

The second most valuable kind of nut tree in the State of Michigan in the hickory. It is quite as common over much the same range of territory as is the black walnut. It has practically the same drawbacks and the same advantages as has that species, but it is a slower grower and is less able to adapt itself to changed environment. Nevertheless, it comprises a number of species and, therefore, offers even greater possibilities in the way of improvement by seed selection. The humble and mis-named pignut hickory is often one of our most handsome tress. By the roadsides of Livingston, Washtenaw, Jackson, and no doubt of other counties of the state, single, handsome, hickory trees usually shagbark or pignut, are not infrequent. More beautiful trees could not easily be imagined. The same as with the walnut, there are differences in the time of leafing out in spring and shedding their foliage in the fall. On September 27, two or three years ago, one shagbark in southern Lancaster County, Pennsylvania, was photographed because of the density and richness of its foliage, when practically all others nearby were practically denuded of their foliage. Good specimens of shagbark rival the best maples for individual beauty and sturdiness.

The Japanese walnut may sometimes be used to goods advantage along highways, provided climatic conditions are not too severe. The tree varies in type the same as do others of the nut group. It is dwarfish in habit and somewhat less hardy than is the black walnut, but rightly used, it is quite satisfactory. The only instance in the country known to the writer in which it has been used as a roadway tree occurs on what is known as the Eastern Shore of Maryland beyond Chesapeake Bay. It would be of doubtful value in Michigan for roadsides, although it is much more hardy than is the Persian walnut and would be more likely to produce crops of nuts.

A native nut bearing tree, all too often overlooked in roadway programs, is the beech. It is rugged in winter, dense and beautiful in summer, but always noble even though often desecrated by those who see fit to carve their initials in its defenseless bark. Its range is mostly north but it grows to great proportions well to the south. The writer has seen beech trees in southeast Georgia along with Magnolia and long leaf pine, all of which grew upward for 60 ft. to the first limbs. In parks the beauty of the beech is often utilized by planting in cool, moist places. It is highly prized by the owners of private estates, wherever it will succeed. On the campus of the Michigan Agricultural College there is one especially fine specimen.

A nut tree which was once a leading species in the forests of the more eastern states, but never appearing naturally in Michigan except in the southern counties, is the chestnut. A bark disease from the Orient, affecting the chestnut, first discovered on Long Island in 1904, has since swept inland to Middle Western Pennsylvania and south to the Virginias. It is continuing to spread and to wreak such destruction that for more than small planting in Michigan, the chestnut cannot now be recommended. Nevertheless, occasionally we find small orchards in the state which seem as yet to have entirely escaped the disease. One such orchard near Cassopolis, seen in April of the present year, is in such condition as to be encouraging to the use of the chestnut along roadways in the southern part of the state at least. However, trees purchased for use in Michigan should come from districts safely outside of any section affected by the bark disease.

A kind of tree in which there is special interest at this time is the filbert, or hazel, whichever you choose to call it. Varieties of European forms are being developed in commercial orchards in the Pacific Northwest. The size to which the European filbert will grow in this country, if given cultural conditions to its liking, is indicated by the trunk of a tree in Portland, Ore., which, when seen 18 months ago, when about 30 years of age, measured 45 ft. 6 in. in circumference, 1 ft. above ground. One year ago, this tree bore a crop of nuts which, before being harvested, was estimated by the writer at about 75 lb.

For various reasons, the European filbert is of uncertain adaptability in the eastern United States. Many plantings, made during the period of our early national history, long ago passed out without having amounted to much. Nevertheless, it should not be left entirely out of consideration for roadside planting. It is tolerant of a considerable amount of shade. In Kent County, England, it is often grown under apple, pear, and other standard kinds of fruit trees; and under the filberts, currants and gooseberries are grown. It is a handsome, rapid growing species, early to begin bearing, and under favorable conditions, it is a heavy bearer. In the Northwest, the European filbert is being used as a general purpose tree. In the outskirts of Portland, Ore., it is not uncommon in chicken parks. It furnishes shade for the poultry, utilizes the fertility of the soil which otherwise would be lost, and produces a crop which the chickens cannot injure.

Our roadside hazel, commonly regarded as a shrub of little value, unquestionably could be trained to tree form by severe pruning. In fact, this is being done by nurserymen and experimenters in other states. Some of the native plants are rapid growers, and freely productive of nuts of large size and fine quality. Here again is afforded a fine opportunity for improvement by selection.

If we wish a species of hazel which will not throw out suckers and which will attain the proportions of a tree of fairly large size, we have it in the Constantinople, or Tree Hazel, Corylus colurna, from Turkey. This species is not common in the United States, nor is it easily propagated. Three trees in Highland Park, Rochester, N. Y., now some 30 years old and probably 35 ft. tall, are without doubt the largest specimens in this country. These trees bear heavily, but not annually. Seeds have been quite generally distributed among amateurs over the country but often they fail to germinate. If wanted in quantity, trees could be had only from foreign countries. In the orchards of the northwestern filbert growers, young tree of this species are not uncommon in the Pacific Northwest where they make rapid growth.

The noblest nut tree of all American species is the pecan. It is strictly American as it is found in nature only in this country and in Mexico, but is rarely found as far north as Michigan. Beautiful trees, sometimes 3 or 4 ft. through at the base and from 100 to 150 ft. tall, occur in the alluvial soils of the Mississippi River and its tributaries and in the Southwest. In the southern states, it forms a splendid roadside tree and orchards of it are worth going long distances to see. Very often enough nuts are gathered from a half dozen trees on a city lot to pay the taxes and to keep up the insurance on the home. There are two trees in Michigan, known to the writer, one on the college campus at East Lansing and the other at South Haven on the grounds of the Sub-Experiment Station. It is quite possible that in the fruit belt of southwestern Michigan, trees of northern origin would succeed satisfactorily, at least so far as tree growth is concerned, but nut production would be uncertain.

Leaving the nut group now with this most superficial discussion, we will touch even more briefly upon a few other kinds of useful trees. There is probably no tree in Michigan quite as popular for avenue purposes and as often used where it will succeed as is the sugar maple. One of the most handsome roadway avenues in the state, so far as kown to the writer, is in Livingston County. This avenue extends for at least 2 mi. on one of the main roads of Marion Township, with a lateral ½ mi. or more to one side. This avenue is the pride of the people for many miles around and, as it is now being made accessible by a newly constructed gravel roadway, it will doubtedless be visited by hundreds of people. It is worth going from Flint or Detroit or Grand Rapids to see, if you are interested in roadway ornamentation. This avenue is not drawn upon for maple syrup or sugar; nevertheless, the hard maple always has potential possibilities for service of that kind.

A quick growing tree, which when rightly chosen and properly cared for, is also long-lived and handsome, is the basswood, or, as known to the park man, the linden. Taking together our American form with the 2 or 3 European species, we have a liberal assortment to choose from. Like the almond in California, which is rarely used as a highway tree, but which is planted in orchards so close to the highway as to amount to practically the same thing, it is a valuable honey tree. Bee men often take their bees considerable distances to basswood trees at blossoming time.

The question of whether to plant apple or other fruit trees along the highway is legitimately open to serious argument—Mr. Colgrove evidently believes in it, judging from his remarks this morning. A farmer in Livingston County whose trees were recently observed wishes that all his apple trees were along the roadway. He finds that while there is some pilferring of the summer apples, the late fall and winter varieties are not disturbed. The apple tree in itself has beauty not to be under-estimated. When in bloom, it is scarcely to be excelled by any other flowering trees. When past its days of fruitfulness, if the trunk is still sound, the body can be sold at a high price for the manufacture of local handles.

Mr. Boehler this morning laid stress upon the shrubs for roadside use as well as upon trees. He particularly emphasized the fact that, in Michigan planting, native species would be largely adhered to. Among the shrubby or dwarf growing trees there is one closely related to the apple which is becoming very popular in the East as a park tree. The reference is to the hawthorne, thorn apple, or haw, whatever you choose to call it. It is very common over this state. When in bloom it is a beautiful plant. Some are of surpassingg beauty at the present time because of their striking combinations of profuse, large, red fruits and dense, dark green foliage. The park authorities in Rochester, N. Y., think so highly of the hawthornes that 12 acres have been planted along the boulevard in Genesse Valley Park, covering a stretch of 2½ mi. In accordance with the advice given by Mr. Boehler this morning, the planting has not been in straight rows but has been grouped loosely in grove-like natural order. The fruits of some of the hawthornes make excellent jellies and to some extent they form food for birds.

In conclusion, let it be made clear that we endeavor to make the roadways as serviceable and as attractive as possible to all the people. We would have beauty spots here and there to delight the spirits of even the most fastidious. We would have open stretches of country for variety; we would use the oaks, elms, ashes, and all the others in their places, both singly and in clumps or rows. Even the quick growing but short-lived poplars and willows would not be entirely discarded—they would be put where more useful trees would not succeed or used to screen off unsightly objects. In spite of our partiality to the productive trees and shrubs we would be liberal to a host of other species that are already here, patiently waiting to be utilized. We would even tolerate the poison sumac because of its beautiful crimson in autumn. We would plant trees and shrubs and vines because we love them and want to love them more and want others to share with us the great joy that comes from knowing and living with plants.

To sum up our position, we would see that every foot of roadside space is put to good use. We would plant trees where trees belong, and shrubs and vines

(Concluded on page 178)

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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ROADSIDE PLANTING

Planting trees along highways is by no means a new departure. It has been done in a number of states, though in a more or less desultory way, for a long time. Connecticut, for instance, made careful provision for saving promising roadside trees, and for planting trees where none were found standing, in the state aid road work done some fifteen years ago.

Of late, the idea has spread very widely and has received the support of public opinion. To a certain extent, this is due to the agitation for roadside trees as memorials to the soldiers of the World War. To some extent, too, it may be the result of the efforts that have been made to awaken public opinion to the absolute necessity of reforestation, if the country's timber resources are not to be entirely exhausted.

Whatever the cause, the plan is now backed by a fairly strong public sentiment and, as is noted in one of the papers on the subject printed on other pages of this issue:

"It is idle to parley over whether or not to plant trees along the highways. Roadside planting is here to stay and increase, despite the eloquence of those who argue that, with the burdens of the farmer already near the breaking point, he will not tolerate encroachment upon his land by roadside trees; that the product of the nut or fruit producing trees will be pilfered by city autoists, or bad boys; that such trees themselves will become public nuisances by being neglected and allowed to become breeding places for insect pests and fungi; that roadside trees are detrimental to the welfare of roads, etc., etc., ad infinitum."

Mr. Reed is undoubtedly correct in the statement that roadside planting is here to stay and to increase. At the same time, the weight of public opinion back of the movement is not so great as it ought to be nor so great as it will have to be if the work is to be carried on as rapidly, intelligently, and thoroughly as it should be.

There are two good and sufficient reasons for roadside planting. One is the beautification of the highways and the other is the strictly utilitarian one of making provision for a future timber supply. There are other reasons, such for instance, as the crops of nuts and fruits that can be raised, but the two stated are the urgent ones.

The matter of beautification probably needs no elaboration. No one, probably, will deny that a tree lined roadway is generally more beautiful than one without trees, or that well selected and carefully tended trees along a road are more pleasing in appearance than a tangled mass of underbush or an unkept growth of scrub timber. It might—and probably would—be difficult to persuade some people that the aesthetic value of roadside trees would be great enough to justify their cost, even though such cost were comparatively little. Fortunately, however, such persuasion is not necessary, for the utilitarian value of the trees is a sufficient argument in itself.

The latter is emphasized in the paper by Mr. Reed, to which reference has been made. A simple calculation will bring out very forcibly the potential value of roadside trees as a source of timber supply.

There are approximately 2,500,000 mi. of public roads in the United States. A tree every 100 ft. along each side of every road in that mileage would mean 264,000,000 trees, which, planted 50 ft. apart, would make a forest of over 15,000,000 acres—about 23,000 sq. mi., or nearly the area of the State of West Virginia. That area is about one-thirtieth of the area of the national forests, in which, it is estimated, there are about 2,214,000,000,000 board feet of timber.

Standardization of Road Signs in England The standardization of direction and warning signs on English roads has been recommended by the British Ministry of Transport in a letter sent out to the local government authorities. The letter is accompanied by drawings and specifications of the proposed standard signs. Their adoption is not compulsory, nor does the ministry advise the replacement of existing signs that are serviceable and satisfactory, but the ministry does urge that local authorities adopt the standards in the erection of new signs and the replacement of those no longer usable.

Roadside Development

(Concluded from page 172)

encroachments, with the service lines on the outer edges of the right of way, and with the remaining space devoted to proper roadside planting there is no question but that it would work out to the advantage of all. It would make far better service at less expense and with less criticism, make more attractive and valuable the abutting lands, and make more beautiful the highways.

Undoubtedly the future will see greater demands for attractive roadsides and it becomes our duty to plan for this by the proper design and control of the whole right of way.

Along many of our roadsides we have beautiful trees now growing as well as shrubs and vines. Some of these trees were planted, but many of them occurred naturally and though they cost the least they are perhaps the most attractive. Along other roads we have no trees or shrubs or vines, nothing to soften the barren appearance of road and pole lines. Which type of road is most pleasing in the spring when the trees are bursting into leaf, in the summer when the unshaded roads are hot and dusty, in the autumn when all nature is a blaze of color, or in winter when the frost glistens on the trees? What is the reason for this contrast between barren roadsides and attractive roadsides? For years we left the planting and care of the roadsides to the owner of the abutting property. If he planted or protected the roadsides properly the results are now attractive, if he planted unwisely or cut everything the results are now barren. For years the highway authorities either neglected the roadsides or cut the so-called brush clean to the highway limits. This brush included young trees and beautiful shrubs and vines but the general plan was to cut all or nothing. Lately there has been an improvement, and in many counties young trees are now being saved. There is still room for improvement. There should be discrimination between the desirable shrubs, vines and young trees, which should be saved, and the undesirable growth, dead brush and weeds, which should be removed. The handling of this work should be left to a few picked men who by their training and experience are able to use discrimination. In general the shoulders, ditches and the space for approximately 2 ft. outside of the ditch line should be kept in grass and mowed clean, while outside of that the weeds, dead brush and undesirable growth should be removed but the young trees and desirable shrubs should be properly pruned and saved. In a few years this sort of work would make attractive many roads that now look unkempt and at a cost far less than that necessary to plant the roadsides and at a saving of considerable time as well. Men should be trained to do this work properly and they should devote their time to it instead of allowing each patrolman to divide his time between road surface and roadsides. The results can be no better than the men doing the work.

Then there is the planting of trees where the roads are barren or have insufficient natural growth. This is not expensive work, indeed it is one of the least expensive items of road improvement. However it requires study by men who know trees and shrubs, who know their relation to the highways, who have the imagination to see the complete highway at its best development twenty-five or fifty years hence. We must plant the trees native to Michigan in the soils best adapted to them, not quick growing trees for immediate effects but the long-lived, substantial varieties for permanent results. In places we should plant in straight rows, in places plant in irregular groups and colonies, in places we should omit planting trees. But each road should be a study in itself to make the best of the future appearance.

In road construction we have made great strides through cooperation, through system and through following the advice and experience of experts. In roadside development the old way has largely been a failure, but with the control of the roadsides in the highway authorities we have the same opportunity to advance in this as in road construction, through cooperation through a study of existing conditions and through handling the work by men who understand it. If we do this work properly the roadsides will increase in beauty from year to year and our highways will become parkways for future generations.

Useful Trees for Highway Planting

(Concluded from page 176)

where shrubs and vines belong. We would use the trees and shrubs that are already there to the best possible advantage, opening up a vista here and there to get a glimpse of the open country beyond, across a lake, up a stream, or into a meadow, where stock might be grazing, or where in the distance there might be a beautiful tree, a house, or a valley. We would plant all our species in the soils intended for them by nature and while we would include many species, we would invariably give first choice to such kinds as will help pay their way and lighten our own burdens and make easier still further planting.

Road Work in Illinois

More than 250 mi. of roads have been paved this year by the State of Illinois, according to a recent report of the Division of Highways. This brings the paved mileage of the state up to 1,365 mi., leaving about 200 mi. of the present paving program to be completed.

Of paving work let to contractors, 89% is completed. Of grading work under contract, 78% is completed and of bridges under contract, 77% of the work is completed.

Bids on 175 mi. of paving will be opened during the month of October.

Highway Work in Indiana

Of the 3,600 mi. of road in the Indiana state highway system, 414.7 mi. are of concrete and about 200 mi. more are hard surfaced with other materials. During the past fiscal year which ended Sept. 30, the state has constructed 70 mi. of paved road.

Rapid Progress on California Road

Last March the California State Highway Commission let a contract for paving with concrete 13.6 mi. of road in Tehama County and on Sept. 16 the entire job was completed. The contract called for a 5-in. reinforced concrete pavement 15 ft. wide and work was started on May 21; accordingly, the concrete was laid in 98 working days, the average progress being 733 lin. ft. per day, or 3.58 mi. per month. A total of 16,625 cu. yd. of concrete was involved, with an average of 170 cu. yd. being placed each working day.

Long Stretch of State Highway Opened in Pennsylvania

Harrisburg-Chambersburg-Gettysburg Triangle, 113 Miles in Length, Formally Thrown Open to Traffic on October 4

The 113-mi. triangle of state highways connecting Harrisburg, Chambersburg and Gettysburg, Penn., was opened with appropriate exercises at Caledonia Park, Harrisburg, on Tuesday, Oct. 4.

One of the features of the celebration was a pageant depicting the development of highway transportation in Pennsylvania. It began with an Indian on horseback and ended with a $14,000 custom built motor car and a heavy motor truck representing present transportation methods. Among those attending were highway officials from several other states.

With the exception of about 2.5 mi. of macadam directly south of Harrisburg and another short stretch of macadam on the United States reservation near Gettysburg, the Harrisburg-Gettysburg and the Gettysburg-Chambersburg sides of the triangle are of concrete construction. The work was done under 9 contracts, having a total length of 54 mi. The average cost was $54,150 per mile, which is regarded by the Pennsylvania officials as remarkably low in view of the fact that 5 of the contracts were awarded during 1919 when prices were high.

The longest job on these two sides was that in York Springs Borough, Latimore, Tyrone, Huntingdon and Strabane Townships, Adams County, which was 10 mi. long. All concrete on that job was laid during a period of 15 weeks this summer, although the grading and drainage were completed last year.

The side of the triangle between Chambersburg and Harrisburg is of bituminous macadam except for a brick pavement in Carlisle Borough.

Bridge Over Newark Bay Vetoed

Permission to build the proposed bridge over Newark Bay between Bayonne and Port Newark, N. J., has been refused by the State Board of Commerce and Navigation. The board held that a bridge would impede and endanger navigation and that ultimately a tunnel will have to be built.

Arkansas Replevins Road Equipment Illegally Sold

Attorney General Utley of Arkansas has started filing about 50 suits in replevin for the recovery of highway equipment which, it is alleged, was illegally sold. This action was taken at the request of the U. S. Bureau of Public Roads, which has been conducting an investigation into the sale of surplus army equipment transferred to the Arkansas State Highway Department.

W. B. Owen, who was state highway commissioner at the time of the alleged illegal sales, states that "There was not an automobile or truck sold which could be driven away under its own power."

◆

Automobilists were Guided by Searchlights on their return from the celebration at Caledonia Park, near Chambersburg, Pa., marking the completion of the state highways connecting Harrisburg, Gettysburg and Chambersburg. The lighting installation was made by the Chamber of Commerce of Carlisle, in order to demonstrate the feasibility of that method of road illumination.

The Maryland State Roads Commission has announced that it has completed road oiling for 1921. More than 350 mi. were covered at a cost of $88,300. This is about the same as the amount expended last year for the same purpose. The roads on the Eastern Shore were covered with the usual tar and crushed stone surface while on the Western Shore asphalt was used exclusively.

The State of Wisconsin is bringing to a close the largest road building program in its history. Nearly 350 mi. of concrete highways have been constructed, all but 80 from county bond issues, at an expenditure of $24,000,000 and an additional $4,000,000 for maintenance. More than 15,000 men have been given employment during the past eight months by road construction. Next season $15,000,000 will be available for road building.

MEETINGS

Calendar of Coming Meetings

Oct. 10-12—North Carolina Good Roads Association.—Annual convention, Greensboro, N. C. Secretary, H. M. Berry, Chapel Hill, N. C.

Oct. 12-14.—League of Kansas Municipalities.—Annual convention, Lawrence, Kan. Secretary, John G. Stutz, University of Kansas, Lawrence, Kan.

Oct. 20-21.—Ohio State Conference on City Planning.—Annual conference, Columbus, O. Secretary, Charlotte Rumbold, Cleveland, O.

Oct. 20-21—Engineers' Club of Philadelphia.—Conference on City Paving. H. E. Hopkins, Secretary, 1317 Spruce St., Philadelphia, Pa.

Oct. 24-28.—American Society for Municipal Improvements—Annual Convention, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Nov. 14-16.—City Managers' Association.—Annual convention, Chicago, Ill. Secretary, H. G. Otis, City Manager, Clarksburg, W. Va.

Nov. 16-18.—National Municipal League.—Annual convention, Chicago, Ill. Secretary, H. W. Dood, 261 Broadway, New York, N. Y.

Jan. 17-20, 1922.—American Road Builders' Association.—Nineteenth Annual Convention, Twelfth American Good Roads Congress and Thirteenth Good Roads Show under the auspices of the A. R. B. A., The Coliseum, Chicago, Ill. Secretary E. L. Powers, 11 Waverly Place, New York, N. Y.

Kentucky Good Roads Association

The Kentucky Good Roads Association held its annual convention at Louisville, Ky., on Sept. 15, passing a resolution providing for submission to the people of the state a proposal for a $50,000,000 bond issue, of which $42,000,000 would be used for building a state highway system and the remainder for other public works.

Robert J. McBryde, of Louisville, was elected president, and the following were elected vice presidents: E. J. Paxton, Paducah; C. H. Petry, Mt. Sterling; William Burkamp, Newport; J. C. Alcock, Danville; Ben Williamson, Ashland; Harvey Myers, Covington; W. L. Edwards, Versailles; Desha Breckinbridge, Lexington; Harry Giovannoli, Lexington, and G. W. Newman, Hawesville.

PERSONAL MENTION

Arthur H. Niles has been appointed city engineer of Sturgis, Mich.

E. R. Thomas has been appointed city engineer of Port Arthur, Texas.

William L. Reeves has ben appointed city manager of Glendale, Cal.

U. Stephens has been appointed county engineer of Runnels County, Texas.

W. A. Bickel, for the past year district manager in charge of the Des Moines branch of the Holt Manufacturing Co., of Peoria, Ill., and Stockton, Cal., has been appointed district manager in charge of the consolidated territory of Iowa and Nebraska. Mr. Bickel will make his headquarters in Omaha.

E. E. Aldous has been appointed representative of the American Steel & Wire Co., Chicago, Ill., in the St. Paul-Minneapolis-Duluth territory, with headquarters in St. Paul. Mr. Aldous has been connected with the American Steel & Wire Co. for the past twenty years.

◆

Because of a Recent Anouncement in New Jersey that there would be no funds available for carrying out the construction of highways for 1922, residents of the state have become so incensed that committees representing farmer organizations have been appointed to work with similar committees of motor organizations in an endeavor to have the next Legislature pass a bond bill that was defeated at the last session. It is said that funds accruing from the motor vehicle fund will be used entirely on the construction of the new bridge across the Raritan River, between Perth Amboy and South Amboy, the Federal Government making it mandatory that this work be completed next year.

The Necessity of Keeping the Country Roads in Good Condition is shown by a report recently compiled by the Bureau of Markets and Crop Estimates of the United States Department of Agriculture, showing the extent to which they are used in hauling farm products to market. According to the report, which shows the tonnage of 11 products hauled for the period from 1915 to 1919 there were 27 tons of these 11 crops hauled for every 100 acres of land. The average tonnage of the 11 crops hauled on country roads each year for the period mentioned amounted to 6,650,000 tons. The 11 crops referred to in the report are corn, wheat, barley, oats, rye, flaxseed, rice, cotton, tobacco and potatoes.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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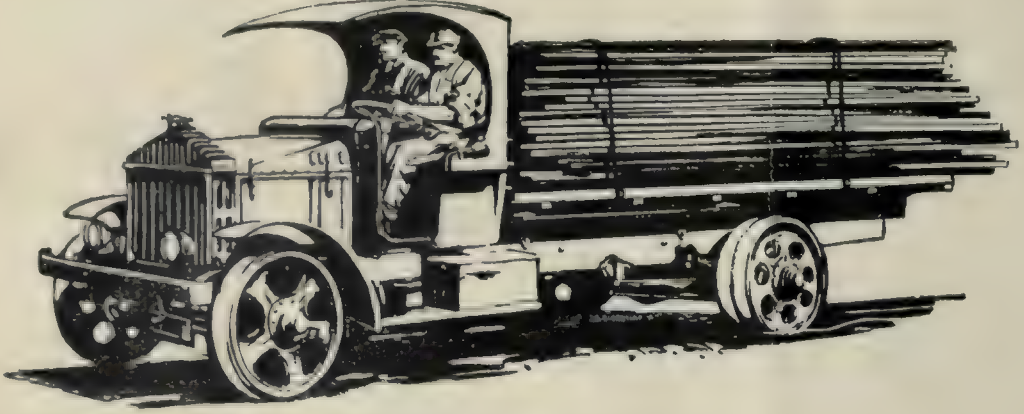

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Vol. LXI. NEW YORK, N. Y., OCTOBER 12, 1921 Number 15

The Illinois Experimental Road--I

Two and One-Half Mile Highway of Over Sixty Different Sections of Cement Concrete, Brick and Asphaltic Concrete Built by the Division of Highways of the Department of Public Works and Buildings to Obtain Data on the Selection and Design of Pavements—Subgrade Tests—Apparatus and Methods

In order to obtain data urgently needed in the selection and design of pavements, the Division of Highways of the Illinois Department of Public Works and Buildings has constructed an experimental road consisting of a large number of different pavement types and has started upon an unusually comprehensive and elaborate series of tests. The road and the studies already made and those to be made in the future are described in considerable detail in the September issue of "Public Roads," the official publication of the Bureau of Public Roads, by Clifford Older, Chief Engineer, and H. F. Clemer, Engineer of Tests, of the Illinois Division of Highways. The matter following is taken from their article.

TEST ON CONCRETE SLAB TO DETERMNE BEARING POWER OF SOIL

APPLYING BITUMINOUS FILLER ON A BRICK SECTION OF THE ROAD

The Bates Road, about 12 mi. southwest of Springfield, was selected for the experiment. The experimental road was built on a new location extending about 2½ mi. east and west, parallel to the Wabash Railroad. It has no curves and the grades vary from zero to 0.4 of 1%, the maximum and minimum grades extending over very short distances. Since the experimental road is on a new locaction and the old highway will accommodate traffic for any reasonable period, the former can be closed to all but the carefully controlled test traffic that is to be applied to it.

The road was constructed by the department's own forces instead of by contract, in order that the engineers might have absolute control over all of the work. The work was started on June 7, 1920, and the first concrete surfacing was placed on Aug. 2. All of the pavement sections have now been completed; pavement test specimens are being tested at set intervals, and the pavements are under observation to determine the effects of temperature and moisture in the absence of traffic.

The road consists of 72 sections and sub-sections with Portland cement concrete, brick, and asphaltic concrete wearing surfaces. Both macadam and cement concrete bases are used with the brick pavement sections and with those of asphaltic concrete. In the brick sections, 3-in. and 4-in. lug and lugless bricks are used, and both the monolithic and semi-monolithic methods of construction have been employed. Many variations in methods of construction have been employed in the different sections, some of which are indicated in the following tabulation prepared from a detailed table in the article.

PAVEMENT TYPES ON BATES EXPERIMENTAL ROAD

I—Portland Cement Concrete:
    20 sections; 50—200 ft. long; 4—9 in. thick; plain and reinforced; with and without transverse and longitudinal dividing planes; crushed limestone and gravel aggregate; special features.
II—Brick:
  1.—Lug blocks; monolithic and semi-monolithic; Portland cement concrete base:
    8 sections; 50—200 ft. long; 3-in. and 4-in. blocks; 2-in., 3-in. and 4-in. foundations.
  2.—Lug and lugless blocks; bituminous filler; Portland cement concrete base; 6-in. curbs;
    14 sections; 75—125 ft. long; 3 in. and 4-in. blocks; 3½, 4, 4½, 5½ and 6½-in. foundations; sand, mastic, and sand-cement cushions.
  3.—Lug and lugless blocks; bituminous filler; macadam base.
    6 sections; 100 ft. long; 3-in. and 4-in. blocks; 1 and 2-course base; 1 and 2-in. mastic, and 2-in. sand cushions.
III—Asphaltic Concrete:
  1.—Macadam or Novaculite Base:
    6 sections; 200 ft. long; 2-in. Topeka, and 1½-in. binder with 1½-in. Topeka wearing surface; 1 and 2-course bases; 4, 5, 6, 8 and 10-in. bases.
  2.—Portland cement concrete base; 6-in. curb:
    12 sections, 25—200 ft. long; 2-in. Topeka and 1½-in. binder with 1½-in. Topeka wearing surfaces; 4, 5, 6, 7 and 8-in. bases.

"The series of test sections for each type or design," according to the article, "cover all reasonable variations in strength that might be expected to give any degree of satisfaction under heavy traffic. Each series begins with a section roughly estimated to be equivalent in strength to 4 in. of concrete and increases to the approximate equivalent of 9 in. of concrete. In comparing the strength of concrete pavements with other types, the following assumptions were made:

"1. That a brick pavement constructed monolithic or semi-monolithic with concrete base has a strength equal to that of a concrete pavement of the same thickness and of the same quality of concrete as that used in the monolithic brick base.

"2. That bituminous filled brick on a concrete base has a strength equal to that of a concrete slab having a thickness equal to that of the base plus one-half of the thickness of the brick surface.

"3. That bituminous concrete surfaces of 2-in. wearing course, or 1½-in. wearing course with 1½-in. binder course, have strength equal to 1 in. of concrete."

Because of the effects of subgrade conditions, every effort was made to provide a uniform subgrade under the entire pavement and careful tests were made upon the soil. Further subgrade tests will be made later under traffic.

The methods employed to secure uniformity of the subgrade are described by the authors of the article to which reference has been made as follows:

"To accomplish this the road was first rough graded to somewhere near the correct elevation. The whole area of the subgrade, including an additional foot of width on each side of the pavement, was then plowed to a depth of 6 in., harrowed, and rolled with a 3-wheeled, 10-ton roller, the roller making not more than two trips over any area. After the side forms had been set to line and grade, the subgrade was carefully finished by hand, and a wooden template riding on the side forms was used to guide the finishing. For the purpose of determining the uniformity of the subgrade under each of the 63 sections comprising the road, observations were made for moisture content and bearing power of soil under both static and impact loads at points 25 ft. apart along the center of the roadway. These observations were made immediately before pouring of the concrete. In addition, samples of the subgrade, secured from different points along the road, were sent to the United States Bureau of Public Roads for soil analyses and laboratory determinations of bearing power."

The bearing power tests of the subgrade are described by Messrs. Older and Clemmer as follows:

The Bearing Power of the Subgrade

"In the study of bearing power of the subgrade an attempt was made to compare the bearing power of the soils under impact as well as static loads. Comparison of the bearing power just before the pavewas laid and at various times after pouring the concrete was also attempted. The points at which the bearing power determinations were made were located 20 ft. apart along the center line of the road on the completed subgrade, and after the pavements were laid the determinations were made through the testing cylinders which will be described later.

"The impact determinations were made with the Golbeck apparatus shown in the photograph on page 183. The apparatus consists of a steel footing 7 sq. in. in base area into which is fitted a ½-in. steel rod about 3½ ft. long. On the rod, fitted loosely so that it can be dropped from any height, is a steel cylinder of 10 lb. weight. The impact can be varied by dropping this weight from different heights. The depth of penetration is measured from a string stretched tightly between two steel rods driven firmly into the ground and set 2 ft. apart. On this string, which just clears the side of the rod, is suspended a small level. After any number of drops of the weight the distances are measured from the string to a given point on the rod with a 6-in. engineer's scale, and are recorded to 0.01 in.

"A special apparatus for making the static-load determinations has been designed by the Illinois highway division. As shown in the illustration on page 183 this apparatus consists of a 3-legged iron pipe frame from which is suspended a Toledo automatic hanging scale supporting a pail which contains about 30 lb. of shot. The load is applied to the subgrade by means of a ½-in. steel rod terminating in a shoe ½-in. in diameter on the bottom tapered back to ⅜-in., ⅛ in. above the bottom. On the top of this rod is a pan which receives the shot from the pail which hangs on the scale, described above. An Ames dial, connected to the frame, with its plunger resting on the support attached to the ½-in. rod, measures the depth of penetration as well as any upward movement of the rod due to elasticity of the soil. A thumb screw set in the frame enables the operator to stop the rod at will. At the 20-ft. distances on the center line of the road an initial reading was taken with the footing resting on the subgrade without any load, after which the shot was released and readings were taken for total loads at 10, 20, and 30 lbs. Additional readings were taken for 2 minutes at intervals of 30 seconds under the 30-lb. load. The load was then removed and the upward movement of the rod, due to the elasticity of the soil, was measured. The 30-lb. load delivered a weight of 150 lb. per square inch to the subgrade. To determine the bearing power after the pavement had been laid, measurements of the penetration under static load were taken through the testing cylinders set in the pavement as well as at points 50 ft. apart along the edge of the pavement. For making these observations the static bearing power apparatus was used, with a shoe 1 sq. in. in area attached. This shoe was used to bring the range of pressure delivered to the subgrade to from 3 to 30 instead of 15 to 150 lb. per square inch. In these observations special attention was paid to time of recovery of the soil after the pressure was removed.

GOLDBECK IMPACT SUBGRADE DETERMINATOR

PENETRATION MACHINE FOR MAKING SUBGRADE STATIC LOAD DETERMINATIONS

Investigation of the Behavior of Soils When Subject to Repeated Loads

"In addition to the observations made for determining the bearing power of the subgrade when subjected to static and impact loads, it is desired to know the effect produced by a load application which more nearly approximates the actual conditions brought to the subgrade when a truck wheel passes over a rigid surface. In this case the load is not, in the strictest sense, a static load, and when the road surface is very smooth there is possibly very little impact. The actual force delivered to the subgrade starts at zero when the influence of the load is first carried through the slab, becomes a maximum when the load is directly over a given point and again diminishes to zero after the wheel has passed some distance beyond the point. From observations made November, 1920, on 7-in. surfaces it was indicated that the influence of an 8,000-lb. wheel load was felt through a distance of 17 ft. on each side of the wheel. This would mean that the pressure produced at any point by a truck running at a moderate rate of speed would increase from zero to the maximum pressure in about one second, and decrease from the maximum to zero in the next second. The repeating load machine, which is shown in the illustration,* was designated to approximate the above condition. The apparatus consists of a pipe frame in which is mounted a cam and spring for producing pressure and a plunger through which this pressure is delivered to the soil. The cam is driven by a 1-16 hp. motor to which power is supplied by a generator set, which is carried in a motor truck. By means of a scale along which a pointer on the spring moves, any desired pressure is registered. The cam revolves at a rate which will produce 10 applications per minute. The movement of the plunger, which is identical with the movement of the soil under the pressure, is shown by an Ames dial. A second Ames dial is used to regulate the machine so as to keep the pressure constant. The different footings range in area from 1 to 10 sq. in. The effect produced upon a soil by these repeated loadings is assumed to be very much like that produced upon a subgrade when a number of trucks travel over a rigid surface. It is supposed therefore that the behavior of the soil under the plunger will be very much like that of the subgrade under a load. By means of this apparatus the data can be secured on the action of the soils of different densities and moisture contents when subject to repeated loads. To obtain some light on the effect of applying loads on areas of different sizes the different footings are used. These footing are loaded from 10 to 50 lb. per square inch, the loads being varied by means of an adjusting screw at the top of the frame.

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* This illustration is not reproduced here. The machine was described and illustrated in a recent issue. See "Determination of the Bearing Power of Soils Under Repeating Loads," by H. F. Clemmer, "Good Roads," Sept. 21, 1921, page 152.

"In addition to the above-described devices for obtaining information on bearing power of subgrades, observations are also being made on the effect of loads applied to concrete slabs 3 ft. in diameter. These slabs are placed on the shoulders directly opposite the pavement sections on which it is proposed to run a series of slab deformation and deflection tests. These circular slabs are subjected to repeated loads of such magnitude as to deliver 10 lb. per square inch pressure to the subgrade and the resulting permanent and temporary settlements are observed by means of Ames dials. The load is applied by a jack placed under the rear of a loaded truck. Information is being secured under conditions of subgrade ranging from normally dry to artificially saturated, the saturated condition being effected by keeping small ditches, round the sides of the slabs, filled with water.

Illinois Subgrade Testing Cylinder

"The special subgrade testing cylinder, shown in the illustration,* has been designed for study of the relative movements of the slab and subgrade. When the last of the cylinders have been set there will be approximately 800 of them in use. * * * * *

"In the concrete sections these cylinders were installed when the pavement was constructed. In the bituminous concrete and brick pavements they were installed after construction of the pavement by boring holes with a Calyx core drill and grouting around them with care so as to assure satisfactory contact with the adjacent pavement. * * * * *

"The difference between initial readings taken as soon as posible after the testing cylinders are placed and readings taken at subsequent times shows any change in position between the subgrade and the pavement.

"These bearing plugs can also be used to obtain data on bearing power of subgrade by loading them with the plunger of the static bearing power determinator.

"By removing the brass bearing plug and iron sleeve, these cylinders afford an excellent means of obtaining subgrade samples for moisture content determination. Also the brass bearing plugs in the cylinders give excellent points for taking precise levels so that the amount of heaving or settling can be determined.

"The testing cylinders are set in rows of 3 and 5 across the pavement, the rows being 25 ft. apart. When 5 cylinders are set in a row they are placed in the center, at the quarter points, and 18 in. from the edges, and when 3 are used, the ones at the quarter points are omitted.

Precise Levels on Pavement

"Bench marks, made by driving a 3-in. iron pipe 4 ft. long approximately 3½ ft. under the ground, were established every 600 ft. along the road. The inner core of the earth was then reamed out with a large auger, and a 1-in. square rod 6 ft. long was driven through the pipe, thus allowing the rod to penetrate the ground below the pipe for a distance of at least 2 ft. Small holes were then drilled in the top of the 1-in. rod and a cap was placed on the 3-in. pipe. Small holes were drilled in the inner brass plug of the subgrade cylinders in order to provide permanent points for taking levels on the pavement. Three cylinders were used at every level station, the cylinders taken being those at the two edges of the pavement and center. The level stations were approximately 75 ft. apart. An ordinary Beckman wye level was used together with a New York level rod reading to 0.001 ft. The rod was plumbed for all readings by means of a small rod level. Since the level points consisted of small holes it was necessary to equip the rod with an attachment whereby the zero point of the rod might rest in the small hole. Therefore a small steel rod about 2 in. long, rounded at the end, was attached to the bottom of the level rod. Levels were taken over the pavement points about once every week and at such additional times as it was deemed advisable due to temperature and weather changes.

Determination of Moisture Content

"For the purpose of obtaining data on the effect of

(Continued on page 190)

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* Not illustrated here. The apparatus has been fully described and illustrated in a previous issue. See "Subgrade Testing Apparatus Used by Illinois Highway Department," by H. F. Clemmer, "Good Roads," March 30, 1921, page 181.

Road Construction in Michigan*

By LESLIE H. BELKNAP †

This is Michigan's banner road building year. Both state and county work has gone forward almost uninterruptedly all season and the roads that will be completed this year are going to mean much to the traveling public next season.

To begin with, 661 mi. of work, some of which was partially completed, was carried over from last calendar year. In addition to this, approximately 500 mi. have been placed under contract this year, making a total of 1,161 mi., representing in money about $22,000,000 worth of work. It is too early to predict how much work will be completed this season, but the progress to date is considered excellent. Of bituminous or cement concrete, there have been completed 64.0 mi. of federal aid roads and 106 mi. of trunk line, making a total of 170 mi. The total of pavement for 1920 was 50 mi. Thus it is seen that we have already completed 20 mi. more than three times as much pavement type as all of last season. We expect that our total for the season will be about 275 to 300 mi. The total for all types, including the above, is 600 mi. The total for all of 1920 was 345 mi., making our total to date 255 mi. more than last year. It is expected that the mileage of all types will be about 1,000 mi. for the season.

One interesting thing to be noted in this year's work is that it took until Aug. 4 to complete a mileage of pavement equal to that carried over from 1920. Most of the jobs were all set and construction started early, so the maximum amount of work was accomplished that could be in the time above mentioned. Had all of this work carried over been let in 1921, the progress on Aug. 4, or to date, would have been very much less. It would, therefore, seem advisable to award pavement contracts where possible the fall in advance. However, this is only safe to both contractor and municipalities where labor and financial conditions are normal. To have placed the 200 mi. of pavement let this year under contract in 1920 would have cost the state more than $1,000,000 in excess. The above phase of the question is mentioned at this time because of the agitation to award at least pavement contracts in advance.

Unit prices reached their peak in 1920. Present prices mean a reduction of about 25 to 30% from last years's prices. Pavement costs averaged about $3.45 in 1920 and have averaged about $2.55 so far this year. Excavation averaged about 79 ct. in 1920 and has averaged 50 ct. this year.

Up to the first of the year, there were approximately 6,370 mi. of road in Michigan's trunk line system. Of this, there are built or under contract at the present time about 4,000 mi., leaving a balance in the trunk line system, as of Jan. 1, 1921, of 2,300 mi. yet to be built. To this there were added by the 1921 Legislature 400 mi. of trunk line road, making a total of 2,770 mi. of unimproved trunk line road. So far our construction has not included very much reconstruction of old state rewarded roads. And if it is possible to hold the greater part of our old state rewarded mileage on heavily traveled roads another two years, Michigan will have completed the greater part of the trunk line system. There is no question as to the necessity of improving some old rewarded roads by the rebuilding of a hard-surface type, but there is the desirability of improving the present unimproved stretches so that Michigan first will at least have a quite passable trunk line system.

Much is being done during the present year in the interests of public safety. Many railroad or interurban crossings have been eliminated by parallelling where possible the railroad or interurban lines instead of crossing the same only to return again within a short distance and by making minor changes in trunk line routes. It is of interest to know that on many long stretches of trunk line road by the above elimination our trunk lines are free from grade crossings. Much remains to be done, however, along the line of elimination, which means for the most of the crossing either overhead or undergrade structures. The cost of these structures runs into considerable sums, but with the law amended so as to distribute the costs more equitably quite a number should be eliminated each year.

Another work of safety has been the building of longer radius curves on right angle turns. On all new construction nearly all right angles are eliminated except where some special condition makes it impossible. It was not found possible to spend much money this season on already constructed trunk line roads to eliminate such turns, but we expect to do much of this in 1922.

The elimination of open ditches received some attention in 1921. On about 15 mi. of road tile was used both sides of the road, the entire length. The use of tile requires a careful study of drainage and will be a problem that will receive more attention in the future. There are other good reasons for placing tile drains in addition to the safety consideration. The main two are: First, it is not very much more costly to place tile drain of the smaller sizes than open drains; and second, the maintenance of open drains

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* Paper presented at the annual meeting of the Michigan State Good Roads Association, Flint, Mich., Aug. 30-Sept. 1, 1921.

† Deputy State Highway Commissioner of Michigan.

Truck Operating Costs a Factor in Highway Economics

The Highways and the Motor Trucks Constitute the Transportation Plant—Reliable Data on Truck Operating Costs not now Available, but Obtainable

The highways and the motor trucks which operate over them together form a plant whose product is transportation. Much public discussion relative to the subject of highways and their construction has occurred in recent years, but comparatively little has been said about their use after they have actually been built.

The public, as a whole, pays for the construction and maintenance of the highway in the form of taxes, and although it is not generally realized, it also defrays the entire cost of the motor truck transportation which passes over the highways in the price it pays for the commodities it buys, for it can be unqualifiedly stated that practically everything purchased has been transported by motor truck one or more times during its process of fabrication.

Therefore, in order to intelligently approach the subject of highway transportation from the economic standpoint, it is necessary to consider the motor truck operation costs, as well as the costs of constructing the highways.

The relative importance of truck operating costs as compared with highway construction costs, can perhaps be indicated by the following figures:

The last complete figures indicate that for the year 1919 about $330,000,000 was expended for highway construction. It is reasonable to assume that the yearly expenditures for this purpose in 1920 and 1921 will not greatly exceed this.

On Jan. 1, 1921, there were 990,000 motor trucks operating over our highways. It is conservatively estimated that their cost of operation exceeds $3,500,000,000 a year. It can be deducted plainly that the ratio is 11 to 1, that is, eleven times as much money is spent in operating trucks over highways yearly, as is spent in building the highways themselves.

The figure of over $3,500,000,000 a year for the cost of motor truck operation may be received incredulously, but I am prepared to prove that this figure errs from the standpoint of conservatism.

From these figures it must be apparent that, important as the economics of highway construction, the economics of motor truck operation concern a topic involving at least eleven times more expenditrue, and as the general public defrays both these bills, the economics of highway transportation cannot be intelligently considered unless they embrace both of the foregoing, not only individually but also in the light of their relationship to each other.

A simile which aptly depicts highway transportation, would be a factory, in which the factory building is the highway, and its product, highway transportation. If by constructing the building more heavily, or of a more expensive design, it would permit the installation of more efficient machinery, manifestly its product could be manufactured more economically, within reasonable limits. On the other hand, if an unnecessarily high type of building were constructed, which did not permit of the installaton of correspondingly efficient machinery, the cost of the product would be unnecessarily high.

It must be plainly apparent, therefore, that the subject of highway transportation economics cannot be intelligently dealt with until the costs of highway construction, the costs of motor truck operation, and their relationship to each other, are determined with reasonable accuracy.

At the present time there are not available any reasonably reliable cost data on truck operation. Some of the truck manufacturers profess to have data, but I have seen little which would stand verification. It is easy to see how they may innocently accumulate misleading data, when it is realized that this information is usually secured for the purpose of assisting their sales, and naturally it is an accumulation of maximums instead of averages.

The difficulty of securing these data is still further complicated by the fact that motor trucks have usually been purchased and operated by a class of men whose education and training have been rudimentary, rarely embracing cost accounting. Even in those instances where trucks have been purchased by large corporations, little real care and attention have been devoted to their cost accounting, both because there was little precedent available for the cost department to use in setting up the systems, and also because the trucks were just a comparatively small annoying detail, not considered as directly productive to the business, and usually under the direction of an ill paid subordinate whose mental attainments were not on a parity with other departmental heads having duties of equal import.

Fortunately, however, there has been developed a system of truck cost accounting which will produce the necessary data, providing a sufficient number of truck operators can be persuaded to truthfully note the comparatively few daily figures this system requires.

Once these figures are available in sufficient quantity, reasonably accurate general average truck operating costs can be determined.

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Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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PLANS FOR SNOW REMOVAL

"The need for uninterrupted traffic in winter and the advantages of keeping the country roads clear of snow have been demonstrated very strikingly during the past few months. * * * * * * Motor truck hauling has been given a great impetus by war conditions, but it is not a mushroom growth that is going to end with the cessation of hostilities in Europe. It has come to stay, and to increase."

The foregoing is from this column of "Good Roads" of March 9, 1918, practically eight months previous to the signing of the armistice. The happenings of the past three and a half years have borne out the contention, for now there can be no doubt that the motor truck is a fixed factor in transportation.

In the spring of 1918 the Highways Transport Committee of the Council of National Defence was urging upon state and other road officials the necessity of making plans for keeping the roads open during the winter to come. With the necessity of winning the war as their chief argument, the committee was able to make considerable progress, securing in some localities the hearty cooperation of the authorities in the preparation of snow removal plans well in advance.

With the ending of the war, one of the chief incentives to preparedness for snow work was removed. In spite of that, however, during the next year and the year following many state and county road authorities continued to get ready during the summer and fall for the snow work of the winter.

There is no reason why the work of preparation should be neglected now. On the contrary, there is every reason why it should be looked after as carefully as ever it was during the war. Motor trucking is growing. One needs only to stand for an hour or so beside a main highway to gain some realization of the progress it has made already. And there is no good reason for expecting anything except still further growth.

Besides the transportation of commodities by motor truck, there is a constantly increasing volume of passenger transportation that demands year-round accommodation. Travel by motor car is steadily increasing—another fact that can be verified by noting how large a proportion of so-called pleasure cars on a main road carry varying amounts of hand baggage.

Forests Get War Bridges Sectional steel bridges, fabricated during the war and designed for the use of the army in France, are being utilized by the Government in the building of roads in the national forests. Road improvement has benefitted to no little extent from the surplus war equipment that has been turned over to road construction agencies, despite the fault finding of those critics who can see no good in the methods employed in the distribution of such supplies.

Truck Costs in Transportation Economics "The highways and the motor trucks which operate over them together form a plant whose product is transportation." The foregoing is the opening sentence in an article on another page of this issue in which there is discussed a point that is too often lost sight of in the consideration of highway economics. It is that the cost of operating motor vehicles is a very real and very material part of the cost of commodities of all kinds.

Road Building to Relieve Unemployment Few of the suggested ways of relieving unemployment possess so much merit as the proposal to provide work for the idle in road building. It is quite true that undertaking extensive public works programs in times of depression increases the public's tax burdens and that the reduction of taxes is desirable in such times. It is also true, however, that taxes utilized for the improvement of a community's highway system constitute an investment that yields handsome returns—not only to that community, but to neighboring communities and to a certain extent to the whole country. It would be possible, of course, for a town, a county, a state, or even a nation, to spend more for good roads than would be justified by the return in cheapened transportation, better communication and enhanced realty values, but there isn't the least danger that any community will go that far. Building roads will help solve the unemployment problem not only by giving work to a large number of men that might otherwise be idle, but also indirectly through the stimulus it will give to every other industry.

Bureau of Public Roads Gets Ready-Made Bridges

Sectional Steel Spans Fabricated for War Use Being Erected on Forest Roads

Sectional steel bridges furnished to the army for use in France have been turned over to the Bureau of Public Roads of the U. S. Department of Agriculture and are being used on roads built by the Government in the national forests.

The sections were built in two sizes, one 17 ft. 7½ in. long and the other 11 ft. 3 in. long. The shorter spans were designed for end sections and the longer ones for intermediate spans. By combining the two kinds, bridges can be built in lengths from 35 to 91 ft. The trusses are 5 ft. 11 in. high and the sections are ready for immediate erection. When completed, the structures have roadways 11 ft. in width.

Road Work to Relieve Unemployment

Good Roads Board of the A. A. A. Urges Federal Appropriation for Road Building to Relieve Unemployment Situation

Giving employment to more than a million men and at the same time promoting one of the greatest and most necessary of public works are urged in favor of the making of federal aid appropriations by Congress in a recent statement issued by the Good Roads Board of the American Automobile Association.

"Expenditures for public roads and bridges outside of incorporated cities will amount to approximately $600,000,000 during the current calendar year," according to the statement. "This vast expenditure is applied to payment of labor, materials, machinery, and profits. Of this sum, approximately $500,000,000, by the end of December, will have gone for the employment of labor. On the basis of $3 per day, this means that during the current year there is being applied to public highways of the country about 166,000,000 labor days. Thus, on the basis of 200 working days, employment will have been given to about 830,000 laborers.

"Hence, if the pending federal aid bill, providing an additional $75,000,000 of federal money to be matched by $75,000,000 of state money during the calendar year of 1922, becomes a law, there will probably be expended during the year on public roads in the United States approximately $800,000,000, of which about $640,000,000 will be applied to the employment of labor. On the basis of $3 per day, and giving 200 working days to each individual, this means that very likely during 1922 more than a million workmen will be employed in the building of roads and bridges and in the manufacture of road machinery therefor throughout the United States.

"It is estimated that during 1921 about $500,000,000 will be expended on street work in the different cities in the United States, and that during 1922 at least $600,000,000 will be expended for this purpose. On this basis, approximately 750,000 laborers will be employed on street work, making a total of 1,750,000 laborers engaged in combined street and highway maintenance and building.

"It would seem, therefore, that the early passage of the pending roads legislation, which would provide for the continuation of this activity, would be a most direct and sensible means of solving the unemployment problem and thus help to restore the national prosperity."

Hints for Engineering Speakers

The following hints were suggested to speakers at the Illinois Short Course in Highway Engineering:

1. Don't apologize for your presence as a speaker. If any apologies are made, let the management make them.

2. Don't tell the audience you are a poor speaker. If it is true, it will be found out soon enough.

3. Be brief. The orator who preceded Abraham Lincoln on the program at Gettysburg talked over two hours; today we don't remember who he was or what he said; Lincoln spoke a few words, and those immortal thoughts are a part of the life of every American. Draw your own conclusions.

4. Marshall your facts. The best extemporaneous speakers are those who have planned in advance what they intend to say and how best to say it.

5. Make every word hit the mark. If a word is not necessary, don't use it. Your are not singing a swan song; you are presenting engineering facts.

6. Be heard! If you prepare the best information of the day, and then smother it by swallowing your voice, mumbling your words and slurring your syllables, your effort will be a rank failure. Every engineer can yell cross-section readings for 600 ft.; he can, therefore, make himself heard by a thousand people. Remember that if you are too quiet, the appointed coach in the rear will yell "louder."

7. Keep within your time limit. The other fellow may have a few valuable things to say also.

The Good Road Program of the State of Tennessee, it is announced, includes the construction of 4,500 mi. at an average cost of $20,000 a mile, making a total cost of $90,000,000. The state has an income from the levy and from the Federal Government of more than $3,500,000 yearly, with which to begin the work. The highway department will turn over to the people this year about 150 mi. of completed roads, it is announced.

MEETINGS

Calendar of Coming Meetings

Oct. 10-12—North Carolina Good Roads Association.—Annual convention, Greensboro, N. C. Secretary, H. M. Berry, Chapel Hill, N. C.

Oct. 12-14.—League of Kansas Municipalities.—Annual convention, Lawrence, Kan. Secretary, John G. Stutz, University of Kansas, Lawrence, Kan.

Oct. 20-21.—Ohio State Conference on City Planning.—Annual conference, Columbus, O. Secretary, Charlotte Rumbold, Cleveland, O.

Oct. 20-21—Engineers' Club of Philadelphia.—Conference on City Paving. H. E. Hopkins, Secretary, 1317 Spruce St., Philadelphia, Pa.

Oct. 24-28.—American Society for Municipal Improvements—Annual Convention, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Nov. 14-16.—City Managers' Association.—Annual convention, Chicago, Ill. Secretary, H. G. Otis, City Manager, Clarksburg, W. Va.

Nov. 16-18.—National Municipal League.—Annual convention, Chicago, Ill. Secretary, H. W. Dood, 261 Broadway, New York, N. Y.

Jan. 17-20, 1922.—American Road Builders' Association.—Nineteenth Annual Convention, Twelfth American Good Roads Congress and Thirteenth Good Roads Show under the auspices of the A. R. B. A., The Coliseum, Chicago, Ill. Secretary E. L. Powers, 11 Waverly Place, New York, N. Y.

New England Conference on Uniform Motor Laws

About 100 public officials and representatives of motor organizations of New England, recently held a meeting at the State House at Boston, Mass., for the purpose of promoting uniform motor laws and regulations throughout New England.

It was pointed out at this conference that in Connecticut there are 89 motor vehicles to each mile of improved highway, to say nothing about the enormous number of cars registered in other states but making frequent passage over Connecticut roads. Much of this interstate traffic is continued over the Massachusetts highways and there is a pronounced divergence of regulations relative to speed, signals, headlights, registration, etc. It was urged that the Boston traffic signals be made the standard for all the cities of New England.

Ohio State Conference on City Planning

An interesting program has been arranged for the third meeting of the Ohio State Conferenc on City Planning to be held at Hotel Deshler, Columbus, O., October 20 and 21.

The first session will be held at 9.30 a. m. preceeded by registration of delegates and visitors. Robert F. Wolfe, publisher, of Columbus, will be chairman and the address of welcome will be made by Mayor James J. Thomas, of Columbus, followed by response by President Morris A. Black, Chairman of the City Plan Committe of the Cleveland Chamber of Commerce. The closing feature will be three-minute reports from representatives of municipalities throughout the state on the year's progress in city planning. There will be a luncheon at noon, followed by a meeting with W. A. Greenlund, President of the Euclid Avenue Association, acting as chairman. "Platting," will be the subject of an address by John E. McCrehen, Chairman of the Legislative Committee of the Ohio State Association of Real Estate Boards.

At 2.30 p. m. Robert H. Whitten, of the Cleveland City Plan Commission will be in charge and Edwin Baxter, Chairman of the Cleveland Heights Zoning Commission will speak on the "Cleveland Heights Zoning Plan." This will be followed by an address on "Public Safety and Traffic Regulation," by Adam Lintz, Secretary, of the Cleveland Safety Council. Charles H. Meeds, Engineer of the Cincinnati Board of Park Commissioners, will lead in the discussion to follow.

A public meeting will be held at 8 p. m. in charge of Col. Edward Orton, Jr., President of the Columbus Chamber of Commerce. "Why a City Planning Commission for Columbus?", will be the subject of an address by Prof. F. H. Eno, of Ohio State University; "Columbus Civic Center," by Frank L. Packard and "City Planning", by George B. Ford, of the Technical Advisory Corporation of New York.

On Friday morning the appointment of the nominating committee will be made and the report of Charlotte Rumbold, Secretary and Treasurer, will be read, followed by the report of the Legislative Committee and the Legislative Program for the Coming Year by Alfred Bettman, Chairman of the Legislaive Committee of the Ohio State Conference on City Planning. The election of officers will then take place.

Following luncheon at the Hotel Chittenden, by invitation of the Columbus Chamber of Commerce, Alfred Bettman will advise as to "How to Go About City Planning."

In concluding the program invited guests and delegates will be the guests of the Columbus Chamber of Commerce, the Columbus Real Estate Board and the Columbus Conventions and Publicity Association.

PERSONAL MENTION

George W. Borden, Assistant State Highway Engineer of Nevada, has been appointed acting state highway engineer.

Rodman Wiley has resigned as chief engineer of the Kentucky Rock Asphalt Co. and has entered the contracting business.

C. V. Conner, formerly with the Delaware State Highway Department, is now assistant engineer with the North Carolina State Highway Department.

◇

The Illinois Experimental Road

(Continued from page 184)

moisture content on the bearing power of soils, samples were taken from the subgrade for moisture content determination at every location where observations for bearing power were made. These samples were inclosed in sealed cans and weighed immediately upon reaching the laboratory. It was first attempted to weigh the sample in the field, but owing to difficulties encountered this method was abandoned after one trial. Ordinarily the weight of one sample was between 300 and 400 grams. Before the sample was placed in the oven the soil was broken into small pieces. The oven was an ordinary gas oven with thermometer attached, except that in later determinations an electric furnace was used. After heating, in many cases, small and very hard lumps were found, but when broken and inspected it was to be seen that all the moisture had not been driven from the sample. When such conditions were found a second heating showed considerable loss and a third and fourth heating were often needed. As a rule when a moisture content of between 12 and 17% was obtained, two dryings were all that was necessary to give a constant weight. The temperature of the ovens was kept constant between 100° and 110° C. If the temperature was allowed to rise above 110° and permitted to remain for any length of time, a certain amount of organic matter was apt to be driven off, thereby introducing an error into the determination. The samples were heated for a period of from 6 to 12 hours and even longer, but 12 hours seemed to be the best length of time for heating.

The Study of the Subgrades by Means of Soil Pressure Cells

"The Golbeck soil pressure cells provide a very convenient means for measurement of pressure in inaccessible places, such as road surfaces against subgrades. Twenty-six of the cells have been installed in the Bates road. For further information regarding this apparatus see 'The Distribution of Pressure Through Earth Fills,' by A. T. Goldbeck, Proc. A. S. T. M., 1917."

(To be concluded)

Road Construction in Michigan

(Concluded from page 185)

as compared with closed drains is costly. Large open drains—that is county drains—cannot very well be eliminated as large tile costs are prohibitive.

The department has not done very much Covert Act construction this year, due to the fact that Covert bonds could not be sold at par, but it seems very possible that these bonds will again be marketable after the first of the year.

As a general summary, we wish to state that we believe that progress this year has been quite satisfactory to all concerned, and while it has not been possible to consider all worthy trunk line projects, we cannot expect to build in three years what we started out to do in ten and has now been cut to a five-year program.

Truck Operating Costs a Factor in Highway Economics

(Concluded from page 186)

Not only would these data be extremely valuable for the foregoing purpose, but they would be of infinite value to the individual truck operators, because, almost invariably, the cost of motor truck operation is greatly underestimated—which explains the extremely high percentage of failures among truck operators and also the reason for so many people entering upon and giving up the business of truck operation each year. There is no industry which compares in magnitude with motor truck operation where those engaged in it possess so little rudimentary knowledge of its costs.

Even though highway transportation has become so firmly knit into the commercial fabric of the country, it must be acknowledged that heavy motor truck line transportation is being done at a needlessly expensive cost.—*Geo. H. Pride in American Highway Educational Bureau.*

◇

The Federal Aid Road Act has been in operation five years with the result that 7,469 mi. of good roads have been completed and 17,977 mi. are under construction, a total equal to a road around the world or about eight times across the continent.

The Virginia Real Estate Association at a recent meeting unanimously endorsed a proposal to have a $50,000,000 bond issue authorized by the State Legislature for the construction of good roads and will put up a strenuous fight to that end at the next session.

190c-

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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Concrete Roads must be Reinforced

It is demonstrated beyond doubt that to make concrete roads proof against heavy motor traffic, weather and time a fabric of steel must be incorporated in the concrete.

Several great States have so ruled.

American Steel and Wire Company's

Concrete Reinforcement

Fulfills Every Engineering Requirement

Send for our book on road building

CHICAGO NEW YORK CLEVELAND
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PERFECT APPLICATION
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will heat and apply all varieties of bituminous products now in use for road construction and maintenance.
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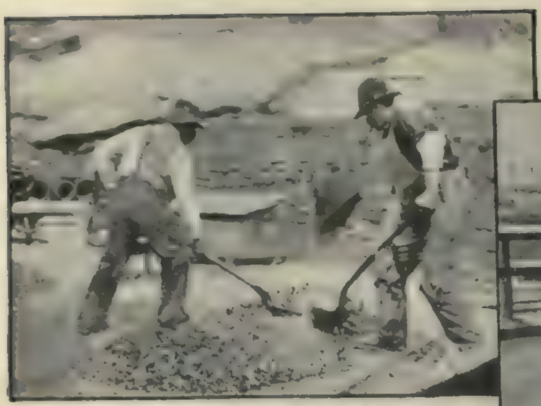
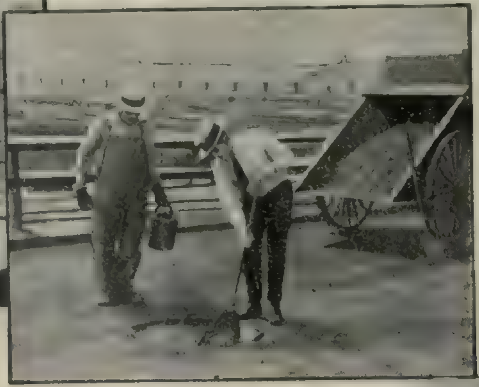
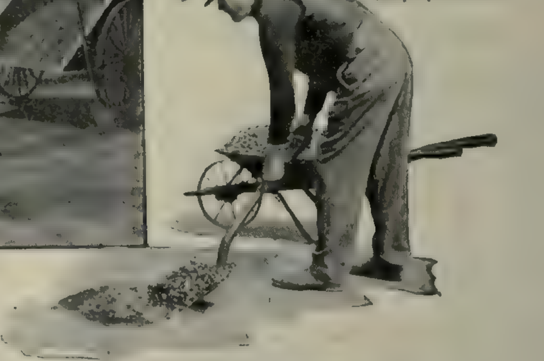


"Tarvia-KP" and stone are turned over by hand until all stones are coated. Then sand is added.

The hole to be patched is cleaned out and the bottom and sides are painted with "Tarvia-KP."

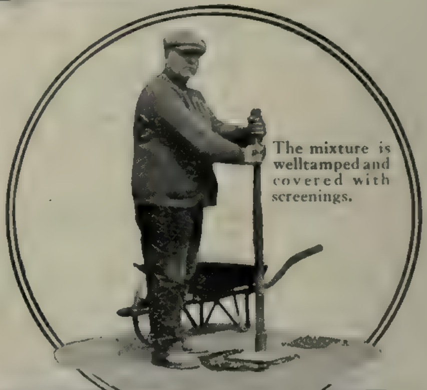


The mixture of "Tarvia-KP," stone and sand is put in the prepared hole.



Tarvia-KP

FOR COLD PATCHING



The mixture is welltamped and covered with screenings.

A Patch in Time Saves Many a Road—

NOW is the time to fortify your roads against the ravages of winter. Patch the surface breaks, fill the depressions —have your streets and highways in ship-shape condition before the first snowfall.

For winter, with its alternate freezing and thawing will ruin a road, whereas a *little* care *now* may mean a vast saving in actual dollars later on.

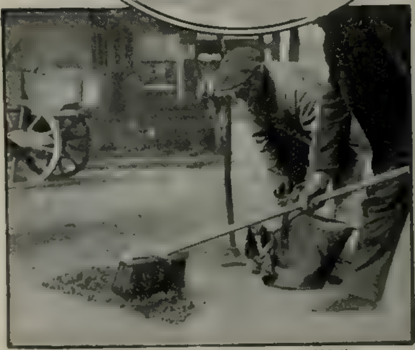
"Tarvia-KP" has an astonishing variety of uses. It is employed in patching macadam, asphalt, bituminous-concrete and cement-concrete roads.

"Tarvia-KP" is a material that can be used for patching at any time of the year—it is as serviceable in winter as in summer, for freezing does not injure it. A batch of the mix can be made today and used weeks hence—in fact, aging improves it.

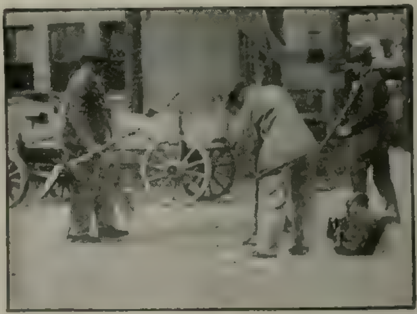
"Tarvia-KP" makes a smooth, perfectly bonded patch—a patch that becomes an integral part of the road itself. A patch that is durable.

There is only one "KP" and that is "Tarvia-KP" patching material made by The Barrett Company.

Our nearest office will gladly send you an illustrated manual of instructions showing each step in patching a road with "Tarvia-KP."



A seal-coat of ½ gallon of "Tarvia-KP" to the square yard is spread over the patch.



Screenings are scattered over the seal-coat and the patch is again tamped.

New York
Detroit
Salt Lake City
Johnstown
Elizabeth
Chicago
New Orleans
Seattle
Lebanon
Buffalo
Philadelphia
Birmingham
Peoria
Youngstown
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GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

WITH WHICH IS INCORPORATED

THE HIGHWAY CONTRACTOR AND ROAD BUILDER

Vol. LXI. NEW YORK, N. Y., OCTOBER 19, 1921. Number 16.

The New Highway Law of Missouri

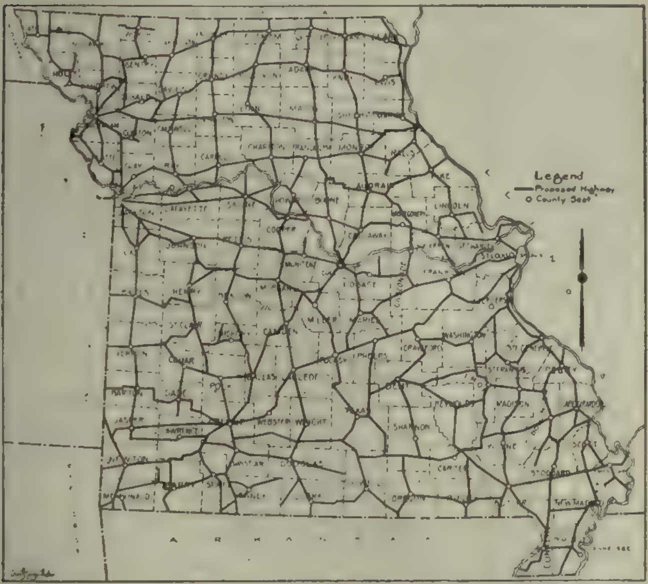
Road Work Under $60,000,000 Bond Issue to Be Carried on by a Commission of Four Appointed by the Governor and a Highway Engineer Appointed by the Commission—Projected System to Consist of 7,700 Miles of Roads, Including 1,500 Miles of "Hard-Surfaced" Pavement—Bond Money Available in 1923

As noted in "Good Roads" of August 17, the Missouri Legislature has passed a law providing for the improvement of a state-wide system of highways with the funds to be obtained from the sale of the $60,000,000 bond issue authorized by the voters at the last general election.

The legislation is the result of a long struggle between opposing factions in the Legislature and much of the credit of bringing these interests into agreement and securing the passage of the much needed legislation is said to be due to Governor Hyde who insisted upon the enactment of a road bill before the adjournment of the special session.

According to the "Missouri Road Bulletin," the official publication of the State Highway Department, it is "the general impression" that the bill will not be subjected to the referendum, its provisions being "so satisfactory that it has but few critics anywhere in the state."

The bill, as passed, provides for the improvement of a system of approximately 7,700 mi. of roads in accordance with the layout shown in the accompanying map. The roads must be built of "properly bound" gravel or its equivalent, but it is specified that the commission may build 1,500 mi. of hard-surfaced highway on lines connecting "centers of population." According to the "Bulletin" this latter provision satisfies the "peacock lane" adherents.



MAP OF THE PROPOSED STATE HIGHWAY SYSTEM OF MISSOURI

A NEW EARTH ROAD THROUGH THE SWAMPS OF SOUTHEASTERN MISSOURI

The administration of the law is vested in a board of four commissioners to be appointed by the governor. They will draw salaries of $10 a day each, with expenses of attending meetings. A highway engineer is to be appointed by the commission, at a salary not exceeding $7,500 a year, and the commission is also to appoint a secretary at a salary of not more than $3,000 a year and an attorney at $3,600 a year. Division engineers and department heads are to be appointed by the chief engineer and are to receive salaries of not over $3,000 a year each. Any commissioner and the chief engineer may be removed from office for malfeasance.

Construction is to be financed from the proceeds of the sale of bonds, but none of the $60,000,000 issue authorized will be available until Jan 1, 1923. The funds, when available, must be apportioned to the 114 counties of the state at the rate of $6,000 per mile, and construction must begin in all counties at as nearly as practicable the same time. A state road can be built through a town only in case the population of that town is less than 2,500. The right of way of every road must be at least 40 ft. wide and changes in the routes specified in the law may be made, for engineering reasons, only between the towns designated.

Provisions are made for reimbursing the counties for roads already built, the adjustment to be made on the appraisal value. The law provides that the commission must maintain all roads, and an additional tax on automobiles, amounting to $300,000 annually, is provided for that purpose.

One of the provisions of the law is that the commission may let the right to place advertising signs along state highways.

The August number of the "Missouri Road Bulletin," the official publication to which previous reference has been made, carries the following announcement relative to the program of work under the new law:

"Everybody is greatly interested in the new highway law as passed at the special session. The Highway Department has been requested to outline its program under that law. To those who have read the law it is no doubt plain that its interpretation into the actual construction of highways in 114 counties of the state involves much preparation and much thought. The building of such a system of highways, of approximately 7,700 mi., can not be planned in a month or in two months. As the program of construction actually develops, new features will occur which may be overlooked at the beginning.

"Taken in connection with the extension of the present law, it is evident that the carrying out of its provisions means a great undertaking. The Highway Department faces the new law with full courage, but without, as yet, a complete knowledge of what the new highway commission will desire. The highway engineer has no fears of the future, but his decision and his acts must be passed upon by the new board before they can be effective. For that reason, a road building program under the new law can not be promulgated at this time."

Nation-Wide Movement Launched to Stimulate Construction

Associated General Contractors of America Commence Campaign to Start Building, as Outlined by the President's Unemployment Conference

Meetings to advocate "an aggressive program" of construction are being held in a number of cities under the auspices and the direction of the Associated General Contractors of America.

At the close of the President's Conference on Unemployment, Secretary Herbert Hoover wrote to W. O. Winston, President of the Associated General Contractors, calling attention to the emphasis placed upon construction as a measure of relief of the unemployment situation and requesting that in the course of the proposed trip to be made by members of the executive board of the association they call attention to the importance of getting under way a construction program. The suggestion was adopted and a series of meetings arranged.

Those who will speak for the contractors' organization are President Winston, of Minneapolis, W. A. Rogers, of Chicago, F. L. Cranford and D. L. Garber, of New York, and G. W. Bucholz, Secretary, and E. J. Harding, Assistant Secretary, of the Associated General Contractors.

The schedule of meetings, as made public to date, including meetings already held and those to be held during the balance of October and in November, is as follows. Minneapolis, Minn., Oct. 17; Des Moines, Ia., Oct. 19; Omaha, Neb., Oct. 20; Denver, Colo., Oct. 21; Salt Lake City, Utah, Oct. 24; Spokane, Wash., Oct. 27; Seattle, Wash., Oct. 31; Portland, Ore., Nov. 1; San Francisco, Cal., Nov. 4; Los Angeles, Cal., Nov. 7; El Paso, Tex., Nov. 10; Dallas, Tex., Nov. 11; Oklahoma City, Okla., Nov. 14; Kansas City, Mo., Nov. 15; and St. Louis, Mo., Nov. 16.

"That the construction program cannot be gotten under way without the organized effort of community and construction interests will be the message carried by the leaders," according to a recent statement issued by the Associated General Contractors. "While the construction of homes, schools, buildings, highways, streets, railroads, public works and repairs of all kinds, reclamation projects and hydro-electric development, as urged by the National Conference on Unemployment, will undoubtedly set to work a million men who will in turn give work to millions more, there is needed first a thoroughgoing analysis of present construction costs in every city, including costs of finance, insurance

(Concluded on page 196)

The Illinois Experimental Road—II

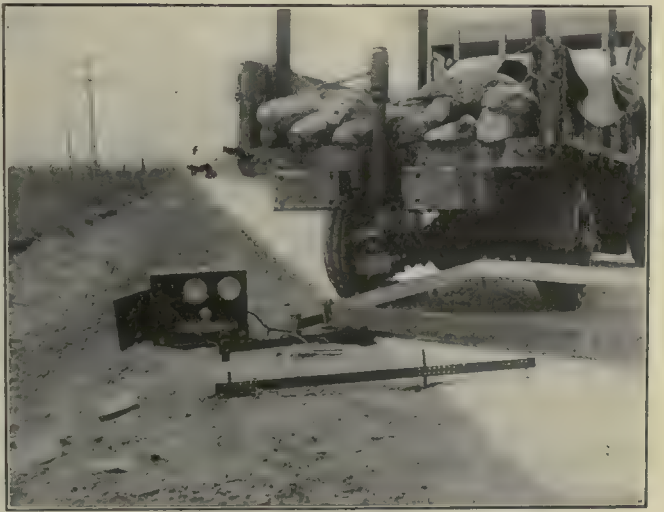
Investigations Now Under Way on the Bates Experimental Road—Tests of Surfacing Material and of Pavement Sections Under Climatic Changes in the Absence of Traffic—Proposed Tests Under Traffic

(Concluded from October 12)

The completion of the experimental road and of the preliminary subgrade tests really marks only the beginning of the studies contemplated by the Illinois authorities, for, as pointed out by Messrs. Older and Clemmer in the article in "Public Roads," while extensive work has been done in research and investigation to secure such information as is needed for road design, "the problems to be solved cover such a large field that it will probably be some time before the data can be so correlated as to be of material assistance to the engineer."

The work now being done is the testing of the road in the absence of traffic, paying especial attention to the effects of moisture and temperature on both the surface and the subgrade, both with and without artificial loading. This is divided into two parts: First, the effect of temperature upon the surface itself; and second, the effect of temperature and moisture on the subgrade.

DETERMINING DEFLECTION AND DEFORMATION OF PAVEMENT UNDER LOAD—SUBGRADE REMOVED



APPARATUS USED TO OBTAIN DATA ON THE DEFLECTION OF PAVEMENTS

Later the road will be tested and studied under rigidly controlled truck traffic. "The trucks are to be carefully weighed," according to the article, "and the weights will be carefully increased from a light load to one 50% greater than that allowed by the present Illinois highway laws. The number and weight of loads required to produce failure in the various sections will then be an index to the behavior of the various types of pavements when subjected to different kinds of traffic. While this information in itself will not contribute to that needed for the design of pavements, it is, nevertheless, of the utmost value. Knowing the conditions of traffic which are to be accommodated, it will afford a means by which a proper pavement can be selected. It may also lead to the saving of millions of dollars each year by preventing the construction of pavements that are found to be incapable of resisting modern traffic. While this information should be of particular value to all engineers dealing with such conditions as are found in the corn-belt area of Illinois, it should also be of considerable value to every one interested in the proper construction of roads."

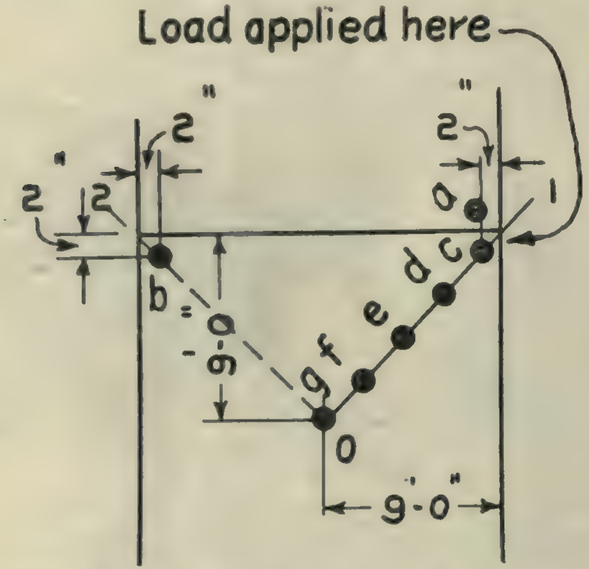
In the first part of this article, printed last week, the testing of the subgrade was described. The following paragraphs, taken from the article in "Public Roads," describe the work done and to be done in the testing of the materials in the pavements and in the studies of the road under traffic.

Surfacing Materials Carefully Tested

"During the construction of the pavements notes were taken daily on all conditions that were thought to affect the setting and curing of the road sections. The condition of the subgrade in the morning, especially after rains, was reported, and any change in the weather during the day as well. The consistency of the concrete at different times, with an average for the day, and the presence of water in the aggregates that would affect the consistency were made part of the record. All mechanical delays caused by the mixer, tamper, and finisher were noted, and where hand finishing was necessary the fact was recorded. Other data pertinent to the specimens, as the proportions of the mix, a description of the type of pavement represented, and brief mention of the character of the aggregate and cement used, were recorded.

"All materials used in the construction were carefully sampled and tested to determine their physical characteristics, and in addition, test specimens of the concrete and other pavement types were made up from the materials entering into the pavement.

"On each 200-ft. section of concrete pavement or base the following test specimens were prepared: 3 slabs for determination of transverse strength; 9 cylinders for compression strength test; and 3 slump test specimens. In order to duplicate as nearly as possible the actual conditions of construction, concrete for these specimens was taken from batches during the run of the day's work. When the pavement forms were ready for filling, samples of the aggregates were taken from the loaded wheelbarrows for the batch selected, a cement sample was taken from the skip of the mixing plant, and the temperature of the feed water was determined. At the discharge of the batch, the boom was swung to the special mixing board and an amount of material sufficient for one slab, three cylinders, and the slump test was deposited. The boom was then returned to the road and the balance of the batch dumped on the subgrade. After initial tamping a shovel full of this concrete was placed in a bucket of water for a wash-mix sample. This wash-mix sample, which is merely the concrete with the cement removed, was taken as a check to determine whether the concrete as mixed actually embodied all the requirements of the mix for that particular section. The sample is prepared in the field by washing the shovel full of concrete in water a number of times, and screening over a 100-mesh sieve to remove the cement. While it is not possible to remove all the cement particles, nor to prevent the loss of some fine sand, the discrepancy may be considered negligible. The value of this form of sample would lie not so much in the individual analysis, but rather in the average of a large number of samples.



LOCATION OF OBSERVATION POINTS IN TEST TO DETERMINE DEFLECTIONS OF SLABS

"The transverse slabs were prepared in steel forms with inside measurements of 8x12x30 in., while the compression cylinders were made in field forms of paraffined strawboard, giving a specimen 6 in. in diameter and 12 in. in height. The specimens were made up as rapidly as possible, rarely more than 20 minutes being required to complete the slab and 3 cylinders. In order to eliminate the personal factor, the labor of preparing the specimens was divided so that one man ran the slump test for every batch, a second man did all the tamping, a third the finishing, etc., for every specimen.

"The test pieces were removed from their forms on the following day, marked with serial number, date, and station, and then placed, one slab with three cylinders, at the edge of the pavement opposite the section they represented. If the pavement was being cured by ponding, the specimens were covered with water for the same period as the sections of the road they represented. In other cases moist earth was used as a covering where that method of curing was employed on the road. Record was made of the time of moving the specimens and whatever conditions affected the pavement were simulated in the treatment of the specimens. Thus, if on a hot morning the pavement was protected from the sun by canvas, then the test pieces were given the same treatment. Wherever possible the cylinders were cured in water for 28 days.

"It is planned to leave the concrete slabs buried in the road shoulders until the section represented is tested by artificial traffic. The slab will at that time be removed to the laboratory and broken on a Riehle testing machine to determine the maximum transverse strength. The slabs are for the most part of Portland cement concrete, varying only in mix and aggregates with the sections they accompany. In special sections test pieces were made so as to incorporate the features of the pavement, as monolithic brick, concrete with mesh reinforcing, concrete with an addition of calcium chloride, or concrete with asphaltic concrete surface.

"One of the 3 cylinders buried with each slab is broken in the laboratory for maximum compression strength when 4 months old, the second after a period of 8 months, and the third will be broken with the transverse slab at the time of testing the road.

Test of Surface Behavior Due to Climatic Changes

"Preliminary to the testing of the road by means of loaded motor trucks information is being sought on (1) the behavior of the various kinds of surfaces when subjected to climatic changes, repeated loads and different subgrade support, and (2) the distribution of

(Concluded on page 200)

GOOD ROADS
CONSTRUCTION TRANSPORTATION MAINTENANCE

Founded January, 1892

E. L. POWERS
Editor

T. A. HULBERT
Managing Editor

11 WAVERLY PLACE
NEW YORK, N. Y.
Cable Address: Gudrodes, New York

Copy for advertisements must reach the New York office by noon on Tuesday of the week before date of issue if proofs are to be submitted.

Copy for classified and other advertisements where proofs are not required will be accepted until noon on Monday of the week of issue.

Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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Vol. LXI. October 19, 1921 No. 16

MISSOURI WILL BUILD ROADS

After much delay, due largely to a prolonged contest between different factions, the Missouri Legislature enacted a state road law in the closing hours of a special session. This was noted in "Good Roads" for August 17. On other pages of this issue the main provisions of the new law are noted.

Several features of the law are admirable. The salary of the highway engineer, for instance, is put at a maximum of $7,500 a year—which is about $2,000 more than the average for the various states, according to the figures of the American Association of Engineers. On the other hand, the salaries of division engineers are fixed at not over $3,000 a year, which is manifestly too low.

Much of the disagreement over the law arose from differences of opinion as to the type or types to be built. One faction was committed to the hard surfaced types, but it was practically defeated, for the law provides that the system—approximatey 7,700 mi. in extent—shall be built of "properly bound" gravel or its equivalent, except that 1,500 mi. of hard-surfaced highway may be built between "centers of population."

Gravel is an excellent road material and the gravel road holds—and will continue to hold—a high place in American highway engineering practice. But with a system composed almost entirely of trunk lines, it is hardly likely that a law stipulating that over 80% of the state's mileage shall be of that type, or its equivalent, will long meet the needs of transportation.

Without doubt, there are other provisions of the law that will demand modification as work progresses, but the law as a whole should prove of great benefit to Missouri in giving the state a start on a definite program of highway betterment.

Formal Openings The frequency with which the completion of new roads is made the occasion of a "formal opening" is one of the evidences of an enhanced popular appreciation of what the highways of a community mean to it and to the country at large. Never since the very early days of the good roads movement, so called, has road betterment seemed to occupy so much of the attention of the people. It is as it shold be.

Contractors Urge More Building The campaign of the Associated General Contractors of America for the stimulation of activity in the building of roads, and in other construction fields, should prove a powerful ally of the proponents of an accelerated program of construction and of business in general as a remedy for unemployment and other business ills. Getting busy is one of the best antidotes for the discontent and restlessness that now afflict the American people.

Uniformity in Motor Vehicle Regulation One of the most important problems that has grown out of the development of motor transportation was discussed at a recent conference of highway officials and representatives of motor organizations at Boston, Mass. The problem—how to overcome the handicap of the confusing and contradictory laws and regulations for the operation of motor vehicles—is a vital one everywhere. It is particularly acute in New England where the smallness of the individual states and the enormous volume of motor travel and trucking have resulted in interstate traffic of unusual proportions.

The Massachusetts Safety Campaign The campaign to curb reckless driving that is being waged by the Massachusetts authorities meets the approval of all decent citizens, whether drivers of motor vehicles or not. The opinion of most operators is that there is less unskillful and careless driving than there was—at least in proportion to the total—but no one can truthfully deny the need for further improvement. There are, and probably always will be, many drivers operating cars and trucks without regard for others. The only effective way of reducing the number of that kind of operators is by means of drastic penalties in all cases in which guilt can be definitely established.

New Jersey Highway Official Urges Larger Federal Road Appropriation

In order to prevent a possible unemployment crisis during the coming winter, Chief Engineer Thomas J. Wasser, of the New Jersey State Highway Commission, is advising local residents to urge upon Congress the necessity of voting a double appropriation of federal highway aid for 1921 and to make it available immediately.

The plan, as outlined by highway officials, follows the suggestion of Herbert Hoover, of the U. S. Department of Commerce. It consists of urging Senators Frelinghuysen and Edge and their respective Congressmen by word of mouth and by letter to give their support to the double appropriations for highway purposes.

If Congress should take the desired action, New Jersey would receive as its share of the double allotment the sum of $2,420,000 and would be in a position to give employment to several hundred men during the winter.

Nation-Wide Movement Launched to Stimulate Construction

(Concluded from page 192)

and bonds, material, labor, transportation and management. Moreover, there must be adequate provision for settling questions in dispute without the great loss of time caused by strikes and lockouts, and there must be sincere cooperation between organizations representing every element of the construction industry.

"To start this work, central committees of general contractors in each of the cities will be appointed as nuclei of a permanent organization. The work now being done by similar organizations affiliated with the Associated General Contractors of America in other cities will be outlined as illustrative of what might be accomplished. Under the direction of Gen. R. C. Marshall, Jr., formerly chief of the Construction Division of the War Department, and chairman of the Construction Committee of the President's Conference on Unemployment, this work has already been organized in from 25 to 30 cities, covering, in some instances, entire states. From headquarters in Washington, Gen. Marshall, as general manager of the Associated General Contractors of America, is already working through national committees of general contractors on labor, materials, methods, contracts, insurance and bonds, transportation, codes, legislation, information and statistics to bring about conditions which will make possible the carrying out of the construction program outlined by the President's Conference.

"The organization of local conference boards, representing architects, engineers, contractors and labor, to handle local jurisdictional disputes and other local construction problems will be recommended. Local committees will be urged to secure the fall letting of public work and highway contracts. Other committees to secure adequate legislation for highway and water power development will be recommended. Investigations in better methods of accounting and estimating and improved contract forms will be suggested. Close cooperation with national headquarters in the entire campaign will be assured through monthly, weekly and special bulletins and reports."

Connecticut Highway Department Gets Work Done at Lower Costs

State Highway Commissioner Charles J. Bennett, of Connecticut, has been able to save 25% on his estimates for concrete pavement work because of the rapid change in prices since June when his departmental allowances were made in the state budget for the next two years.

The expense of one section in the highway system had been estimated at $60,000 a mile, but the contract was placed at $45,000. As Connecticut spent $7,127,960 on its highways for the fiscal year ending July 1, the lower cost is expected to mean an expanded program for developing the highways across the state.

Lower Freight Rates on Road Materials Ordered in Ohio

Following a recommendation made by J. W. Herrold, Chief of the Division of Rates and Service, the Ohio State Public Utilities Commission has ordered a restoration of freight rates in effect prior to the 40% increase in October, 1919, as it pertains to road building materials, which include sand, gravel and crushed stone. The reduction amounts to 28.5% from the present rates.

To the above reduction, paving brick received 10 ct. a ton additional to offset partly the 40 ct. a ton increase made while the roads were under federal control, other road building material receiving at that time only 20 ct. a ton increase. Slag was not included in the order as a 22% reduction on this had previously been ordered by the commission. Cement, sandstone block and curbing also, were left out of the order, the commission holding that insufficient evidence had been introduced to warrant reductions on these materials.

While the hearing was in progress the railroads offered reductions which the commission said amounted to from 9 to 10% on the present rate, but the offer was spurned by the road material interests. It is estimated that the ruling will save the public at least $1,000,000 a year on highway costs.

The State Road Commission of West Virginia has issued more than 90,000 automobile licenses for the last quarter of this year, according to C. E. McCoy, chief of the automobile registration division. This number is 22,000 more than were issued at this time a year ago.

Road Appropriations in Virginia

State Highway Commissioner George P. Coleman, of Virginia, will recommend to the 1922 session of the Legislature of that state an appropriation sufficient to provide for rebuilding and widening of roads now under maintenance by the department. Approximately 2,000 mi. have been taken over by the State Highway Department, 1,200 of which require resurfacing and widening.

July Federal Aid Projects

Road projects costing an aggregate of $7,693,778, covering more than 265 mi. in 18 states, or an average of $29,000 per mi., were approved during July by the Bureau of Public Roads, of the U. S. Department of Agriculture, for federal aid, the total of which approved for these projects is placed at $3,023,152, the remainder of the cost being borne by the states.

There were 56 such projects approved during the month. New York led with 20; Pennsylvania came second with 7, and Kentucky and South Carolina tied for third with 5 each. Four Texas projects were approved; New Mexico, Washington and Wisconsin had 2 each; Arizona, Arkansas, Kansas, Maine, Massachusetts, Michigan, Mississippi, Oklahoma, Tennessee and Virginia each one project approved during the month.

State May Build Roads in Maryland Cities

As the rseult of a recent meeting of representatives of 14 Maryland municipalities, including 10 mayors, in the office of Governor Ritchie, a committee was appointed to press the fight to have the state build its roads through the cities in the future and to refund the cities for streets built in the past to connect the state highways on either end of the different towns.

The mayors and other representatives presented their plea to Governor Ritchie, together with John H. Mackall, both of whom looked with favor on the project with the exception of the question of refunds for streets already built. Mr. Mackall estimated that this would cost the state approximately $1,250,000, while the Governor declared it would mean the reversal of the policy carried out in building state roads since 1908 and generally agreed to by all towns.

Another point in which, it appeared, the mayors and the state administration may not find themselves in entire accord, related to the control of the streets after they are built through the towns by the state. The municipalities favored placing this control in the hands of municipalities, guarded by certain conditions which were not stated. One thing asked for by the municipalities, however, was the right to cut into such streets for laying public utility services or other purposes.

Col. D. John Markey, of Frederick, chief spokesman of the delegation; Mayor Earl Orem, of Cambridge, and City Counsellor Hugh Riley, of Annapolis, were named as the special committee to take up the matter further with Mr. Mackall and the Governor at a conference to be held later.

Those who attended the conference in addition to Governor Ritchie, were: Mayors Orem, Howard Koontz, of Westminster; T. W. Koon, of Cumberland; O. R. Rice, of Frostburg; Harry D. Hanway, of Belair; D. F. Fooks, of Snow Hill; Arthur Kennerly, of Salisbury; Thos. A. Gonder, of Oakland; Horace Davis, of Berlin; Francis G. Wrightson, of Easton; Alexander Hanger, Hagerstown.

Atlantic City-Philadelphia Route Complete

Six thousand persons, including members of the highway commissions of New Jersey and Pennsylvania were present at the recent dedicatory ceremonies following the completion of the White Horse Pike connecting Philadelphia with Atantic City, a distance of 62 mi. at a cost of $1,500,000.

The ceremonies were held off Albany Avenue, Atlantic City, and were preceded by an automobile run over the new road beginning at Camden. More than 600 cars bedecked with flags and streamers contained enthusiastic boosters of good roads. In the leading car was Mayor Edward L. Bader of Atlantic City.

Among those participating in the celebration were Mayor Ellis of Camden, Colonel Walter Whittemore, of the New Jersey Highway Commission, who spoke on the need of good roads, and Borton Weeks, President of the Keystone Automobile Club, of Philadelphia, who declared that Pennsylvania has paved over 400 mi. of roads last year and the program this year called for 600.

Massachusetts Campaign Against Reckless Driving

Seeking to lessen the automobile death toll during the present month which is regarded one of the biggest of the entire year, State Registrar of Motor Vehicles Frank A. Goodwin, of Massachusetts, has sent to all the police chiefs of that state, a letter, asking their cooperation in taking the speed maniacs and drunken operators off the highways.

In speaking of the October death toll, Mr. Goodwin said: "We have just analyzed 400 accidents in which there were 208 persons killed and 253 seriously injured, and I am calling the result to your attention in order that you may know wherein a stricter enforcement is necessary.

"Of these accidents 313 happened in business or thickly settled residential districts and 87 in sparsely settled districts. Of the 208 killed, only 49 were occupants of automobiles; 144 were pedestrians, 76 of them being children; two occupants of wagons, 5 motorcycle riders and 6 bicycle riders and 2 coasters."

Speeding is given as the cause of 131 accidents while 40 were caused by drunken operators; 30 were caused by "cutting in" and 37 from operating on the wrong side of the road.

MEETINGS

Calendar of Coming Meetings

Oct. 20-21—Ohio State Conference on City Planning.—Annual conference, Columbus, O. Secretary, Charlotte Rumbold, Cleveland, O.

Oct. 20-21—Engineers' Club of Philadelphia—Conference on City Paving. H. E. Hopkins, Secretary, 1317 Spruce St., Philadelphia, Pa.

Oct. 24-28.—American Society for Municipal Improvements.—Annual Convention, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Nov. 14-16—City Managers' Association.—Annual convention, Chicago, Ill. Secretary, H. G. Otis, City Manager, Clarksburg, W. Va.

Nov. 16-18—National Municipal League—Annual convention, Chicago, Ill. Secretary, H. W. Dood, 261 Broadway, New York, N. Y.

Jan. 17-20, 1922—American Road Builders' Association.—Nineteenth Annual Convention, Twelfth American Good Roads Congress and Thirteenth Good Roads Show under the auspices of the A. R. B. A., The Coliseum, Chicago, Ill. Secretary, E. L. Powers, 11 Waverly Place, New York, N. Y.

American Society for Municipal Improvements

The twenty-seventh annual convention of the American Society for Municipal Improvements will be held on Oct. 25, 26, 27 and 28 at the Southern Hotel, Baltimore, Md. On the morning of the first day the committees on specifications will meet and at 11 a. m. the convention will be formally opened. In the afternoon the following will be presented: Report of the Committee on Street Lighting, by C. W. Koiner, Chairman, City Manager, Pasadena, Cal.; "Street Lighting and Public Safety," by Earl A. Anderson, National Lamp Works, Cleveland, O.; "Street Lighting," by C. A. B. Halvarson, Jr., General Electric Co., West Lynn, Mass.; "Ornamental Street Lighting," by L. A. S. Wood, Westinghouse Electric & Mfg. Co., South Bend., Ind.; "Electrical Conduits," by Charles Goob, Chief Engineer, Electrical Commission, Baltimore, Md.

Wednesday morning, Oct. 26, will be devoted to papers on sewerage and sanitation. In the afternoon an inspection trip will be made of Baltimore's harbor.

On Thursday morning, Oct. 27, the following papers will be presented: Report of General Committee on Street Paving and Street Design, Street Maintainance and Street Railway Construction, by W. A. Howell, Chairman, Chief Engineer, Bureau of Paving, Newark, N. J.; Report of Sub-Committee A on Street Paving, by K. C. Kastberg, Chairman, civil engineer, Des Moines, Ia.; Report of Sub-Committee B on Sidewalks and Street Design, by E. R. Conant, Chairman, City Manager, Mansfield, Mass.; Report of Sub-Committee C on Street Maintenance, by George H. Norton, Chairman, City Engineer, Buffalo, N. Y.; Report of Sub-Committee D on Street Railway Construction, by C. A. Poole, Chairman, City Engineer, Rochester, N. Y.; "Granite Block Repaving in Baltimore," by Nathan L. Smith, Associate Civil Engineer, Paving Commission, Baltimore, Md.; "Experimental Pavements in Borough of Queens," by E. E. Butterfield, in charge of Borough of Queens Laboratory, Long Island City, N. Y.; "Experimental Wood Block in Minneapolis," by E. M. Hunt, U. S. Forest Products Laboratory, Madison, Wis.; "Street Designs," by P. L. Brockway, City Engineer, Wichita, Kan.; "Street Maintenance," by A. E. Christhilf, Highway Engineer, Baltimore, Md.; "Cooperative Investigation by the U. S. Bureau of Public Roads Upon the Cause and Correction of Shoving of Asphalt Pavements," by Prevost Hubbard, Chemical Engineer, the Asphalt Association, New York City; "The Economical Extent of Pavement Repairs and Maintenance," by George H. Norton, City Engineer, Buffalo, N. Y.; "Paving Maintenance," by C. J. Van Etta, Superintendent of Street Construction and Repair, Milwaukee, Wis.; "Plant Inspection of Paving Material," by George Cobb, Baltimore, Md.; "Design and Strength of Concrete," by E. E. Butterfield, in charge of Borough of Queens Laboratory, Long Island City, N. Y.; "The Present Aspect of the Paving Brick Industry and the Relation of the Manufacturers to Municipal Engineers," by Raymond L. Winslow, President, Eastern Paving Brick Manufacturers' Association, New York City; "The Real Value of Highway Literature," by C. E. Murphy, the Texas Co., New York City.

On Thursday afternoon the following reports of the committees on specifications will be presented: "Sheet Asphalt Pavements," by Herman H. Smith, Chairman, Assistant City Engineer, Department of Public Works, New York City; "Bituminous Macadam, Bituminous Concrete and Asphalt Block Pavements," by Linn White, Chairman, Chief Engineer, South Park Commission, Chicago, Ill.; "Broken Stone and Gravel Roads, with or without Bituminous Surface Treatment," by Harry F. Harris, Chairman, County Engineer, Mercer County, New Jersey; "Brick Pavements," by George F. Fisk, Chairman, Assistant Engineer in charge of pavement construction, Buffalo, N. Y.; "Cement Concrete Pavements," by H. E. Breed, Chairman, Consulting Engineer, New York City;

-"Stone Block Pavements," by R. A. MacGregor, Chairman, Assistant Engineer, Department of Public Works, New York City; "Wood Block Pavements," by Ellis R. Dutton, Chairman, Assistant City Engineer, Minneapolis, Minn.; "Sidewalks and Curbs," by Sylverius Sammelman, Chairman, Principal Assistant Chief Engineer, Sewers and Paving, St. Louis, Mo.; "Subgrades and Foundations," by Frederic A. Reimer, Chairman, County Engineer, Essex County, New Jersey; "Street Railway Pavements," by Charles E. DeLeuw, Chairman, civil engineer, Chicago, Ill.; "Standard Tests for Bituminous Materials," by Francis P. Smith, Chairman, Consulting Engineer, New York City; "Standard Tests for Non-Bituminous Materials," by Arthur H. Blanchard, Professor of Highway Engineering, University of Michigan.

On Friday morning, Oct. 28, the following will be presented: Report of the Committee on Traffic and Transportation, by Arthur H. Blanchard, Professor of Highway Engineering, University of Michigan; Subways for City Transportation, by Robert Ridgway, Chief Engineer of Construction of Subways, New York City; Report of General Committee on Street Cleaning, Refuse Disposal and Snow Removal, by Morris R. Sherrerd, Chairman, Chief Engineer, Newark, N. J.; Report of Sub-Committee on Street Cleaning, by A. Prescott Folwell, Chairman, Editor, "Public Works," New York City; Report of Sub-Committee B on Refuse Disposal, by John Swan, Chairman, formerly Director of Public Works, Pittsburgh, Pa.; Report of Sub-Committee on Snow Removal, by T. F. Sullivan, Chairman, Commissioner of Public Works, Boston, Mass.

On Friday afternoon, Oct. 28, an automobile tour of Baltimore will be made.

City Paving Conference at Philadelphia, Pa.

An unusually interesting program has been arranged for the city paving conference to be held in Philadelphia October 20 and 21 under the auspices of the Engineers' Club of Philadelphia with the cooperation of the Society of Municipal Engineers, Philadelphia section; the Department of Public Works, Bureau of Highways and Surveys of Philadelphia; the Civil Engineering Department of the University of Pennsylvania; the Philadelphia Chamber of Commerce; the Baltimore City Paving Commission; the Department of Public Works, Borough of Manhattan, New York, N. Y., and the Advisory Board on Highway Research, Washington, D. C.

The morning session of the first day will be in charge of Benjamin Franklin and the address of welcome will be made by William F. James, President of the Engineers' Club of Philadelphia. A. T. Goldbeck, Engineer of Tests, U. S. Bureau of Public Roads, will speak on "The Structural Design of Pavements, Including Subbase Considerations and Economic Depth of Foundations." R. A. MacGregor, Engineer, Department of Public Works, Borough Manhattan, will speak on "Preparatory Steps; Extension and Repairs of Surface and Sub-surface Structures."

Julius Adler, Deputy Chief of the Bureau of Highways, City of Philadelphia, will preside at the afternoon session. C. M. Pinckney, Chief Engineer, Department of Public Works, Borough of Manhattan, New York, N. Y., will speak on "Factors Determining Selection of Type." This will be followed by an address on the subject, "Relation of City Pavening and Zoning to the Selection of Type of Pavement," by Jefferson G. Grinnalds, Secretary of the Zoning Commission of Baltimore, Md.

The general topic for the afternoon session will be "Recent Developments and Recommended Changes in Practice," under which the following adresses will be made: "Vitrified Brick," by P. C. Painter, City Manager of Greensboro, N. C.; "Wood Block," by Ellis R. Dutton, Assistant City Engineer, Minneapolis, Minn.; "Concrete," by D. S. MacBride, Lancaster, Pa., and B. H. Wait, New York, N. Y.; "Hydrated Lime in Paving Concrete," by Tyrrell B. Sertzer.

W. H. Connell, of the Philadelphia Rapid Transit Co., will preside at the meeting to convene at 8 p. m., at which the program of the preceding session will be continued as follows: "Granite Blocks," by C. D. Pollock, consulting engineer, New York, N. Y.; "Asphalt Pavements," by Julius Adler, Deputy Chief, Division of Highways, Philadelphia; "Design of Bituminous Mixtures," by Maj. F. S. Besson, Corps of Engineers, U. S. A., Assistant to Engineer Commissioner, Washington, D. C.; "Native Lake Asphalts and Their Relation to City Paving," by J. S. Miller, Chief Chemist, Barber Asphalt **Paving Co.**

Under the general subject of "Guarantees and Inspection," the following addresses will be delivered: "Inspertion; a Remedy for Guarantees," Prof. S. A. Stephenson, Jr., Associate Engineer of Civil Engineering, Rutgers College; "Paving Inspection from the Viewpoint of the Contractor," by Thomas S. Martin, 3rd, representing the Associated General Contractors of America.

Friday's sessions, with C. M. Pinckney presiding, will be occupied as follows. "When Is Repaving Justified?" by George H. Norton, City Engineer of Buffalo, N. Y.; "Resurfacing and Reconstruction of Old Pavements," by Jacob Schmitt, Chief Engineer of Highways, Brooklyn, N. Y.; "Causes of Destruction of Pavements and Paving Materials," by Dr. Felix Kleeberg, Department of Public Works, Borough of Manhattan, New York, N. Y.

At the afternoon session, William F. James, presiding, papers will be presented as follows: "Regulation of the Disturbance of Pavement," Col. R. Keith Compton, Consulting Engineer, Bureau of Paving, Baltimore; "Repair and Maintenance Problems Affecting City Paving," P. P. Sharples, Manager, General Tarvia Department, The Barrett Co.; "Paving Between Tracks and

Adjoining Rails; Proper Construction of Street Railway Tracks," E. J. McIlraith, Engineer of Way, Philadelphia Rapid Transit Co.

PERSONAL MENTION

O. A. Seward, formerly City Engineer of Beaumont, Tex., is now resident engineer for the Nagle, Witt, Rollins Engineering Co. in Potter County, Texas.

C. C. Cottrell has resigned as state highway engineer of Nevada and has succeeded Ben Blow as manager of the Good Roads Bureau of the California State Autobile Association.

The Illinois Experimental Road—II.

(Concluded from page 194)

loads across joints and through pavement sections of different thicknesses and types.

"For obtaining data on deflection of the various sections when subjected to different temperatures as well as to repeated loads, 8 Ames dials are set on any slab, as shown in the illustration. The following procedure is used in each case. The dials a and b are independently supported while c, d, e, f and g are set in a beam which rests on two supports, one placed on the shoulder and the other placed in the subgrade through a hole in the center of the slab. Two thermometers are used, one for recording the air temperature and the other for obtaining the temperature of the concrete. Four sets of observations are made on each slab. In the first set of observations, which is made for determining the effects of change of temperature only, readings are taken on the thermometers and dials every half hour for 12 hours. In the second set of observations, taken for the purpose of determining the deflection caused by loads applied to the corners of the slabs, readings are taken for 24 hours at half-hour intervals. From 4,000 to 6,000 lb. is applied at the corner every hour. A reading is taken and the load immediately released. One-half hour later a reading is taken without the load. The results obtained already show the measurement of the load deflection would be futile without the determinations of temperature changes, because the warping of the surface due to temperature variations greatly exceeds the deflection under the loads applied.

"For the purpose of securing some idea of the effect of the supporting power of the subgrade on the deflection of the slab after the 24-hour run, the subgrade is excavated under the corner and several observations made to determine the difference in deflection of the slab when supported and when not supported by the subgrade. During the loading tests, a strain gauge is set along the diagonal for the purpose of securing some idea of the deflection of the upper surface. For the first 12 hours of the loading run, the dials are set along the diagonal 0-1, and for the second 12 hours along the diagonal 0-2. This work is carried on by a corps of engineers divided into three shifts each working 8 hours so that continuous readings are made day and night.

"For determining the distribution of loads across joints and through pavement slabs of different thicknesses and types, soil pressure cells are placed under corners and centers of the slabs, and two Ames dials are set—one on each side of the joint about 2 in. from the edge of the pavement. A thermometer is supplied for registering air temperature. After the apparatus has been set up a loaded truck is brought slowly toward the point with its outer wheel about 6 in. from the edge of the pavement. The truck is stopped as soon as the dials give the first indication of the deflection of the pavement. Readings on the dials and the pressure cells are then taken, stopping the truck every 2 ft. to the joint and every 2 ft. beyond the joint till the dials again indicate that the truck is so far away as to cause no deflection. Because of the warping action of the slab and the temperature change these readings are made at night as well as day, the daylight readings being taken between 9 a. m. and 4 p. m., and the second set the same day between 9 p. m. and 4 a. m. Especial attention is given to securing definite time intervals for each loading. It is proposed to make these observations once every month.

"In connection with the above, a comprehensive survey of cracks developed in the different types of pavements has been undertaken. At different times each section is observed and all cracks noted These cracks are all plotted on a large tracing, using lines of different kinds for designating the cracks as found at different times. In addition also a considerable number of representative cracks have been measured by micrometers, the measurements being taken day and night, one each week. This study covers both transverse and longitudinal cracks.

"The traffic test of the road will be accomplished by means of a battery of 10 motor trucks driven by trained operators. The loading of the trucks will be increased after each 1,000 trips. The actual magnitude of the loads will be dependent upon the information secured from the above described preliminary investigations, although the maximum wheel load will probably not exceed 12,000 lb., which is 50% greater than the legal Illinois wheel load.

"The construction work on the road was supervised by E. M. Fleming and R. R. Benedict under the direction of B. H. Piepmeier, Engineer of Construction.

"The research work is under the immediate direction of H. F. Clemmer, Engineer of Tests, with C. A. Hogentogler, Highway Engineer of the United States Bureau of Public Roads, cooperating."

North Carolina will award contracts totaling $3,000,000 for road improvements during the months of October and November, it is reported.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

PUBLISHED EVERY WEDNESDAY BY
THE E. L. POWERS COMPANY
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*Illustrated article

Concrete Roads must be Reinforced

It is demonstrated beyond doubt that to make concrete roads proof against heavy motor traffic, weather and time a fabric of steel must be incorporated in the concrete.

Several great States have so ruled.

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"Tarvia-KP" and stone are turned over by hand until all stones are coated. Then sand is added.

The hole to be patched is cleaned out and the bottom and sides are painted with "Tarvia-KP."

The mixture of "Tarvia-KP," stone and sand is put in the prepared hole.

Tarvia-KP

FOR COLD PATCHING

The mixture is welltamped and covered with screenings.

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NOW is the time to fortify your roads against the ravages of winter. Patch the surface breaks, fill the depressions—have your streets and highways in ship-shape condition before the first snowfall.

For winter, with its alternate freezing and thawing will ruin a road, whereas a *little* care *now* may mean a vast saving in actual dollars later on.

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Our nearest office will gladly send you an illustrated manual of instructions showing each step in patching a road with "Tarvia-KP."

A seal-coat of ½ gallon of "Tarvia-KP" to the square yard is spread over the patch.

Screenings are scattered over the seal-coat and the patch is again tamped.

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GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

WITH WHICH IS INCORPORATED

THE HIGHWAY CONTRACTOR AND ROAD BUILDER

Vol. LXI. NEW YORK, N. Y., OCTOBER 26, 1921. Number 17.

Motor, Accidents and Road Conditions

Maryland Study Leads to Unexpected Conclusions—Straight, Level Roads with Light Traffic Often Mere Dangerous than Sharp Curves, Heavy Grades and Great Traffic Density—90% of Accidents due to Speeding.

The fact that more accidents occured on straight road in Maryland than on curves or at cross roads was noted in these columns in the issue of July 20. In the September issue of "Public Roads," the official publication of the U. S. Bureau of Public Roads, Harry D. Williar, Jr., Assistant Chief Engineer of the Maryland State Roads Commission, sets forth in more detail the results of the study that has been conducted in that state to determine the causes of accidents upon its highways.

The outstanding fact that has been determined is that few of the 94 accidents that occurred during the three months over which the study was conducted were due to faulty location or construction of the roads on which they happened. It is further stated that in the 20 cases in which road conditions were given as the immediate cause, wet surfaces were the causes.

The Roads Commission bases its conclusions upon reports furnished by the patrolmen. These reports, made upon blanks supplied by the state, carry complete information as to the nature of the accidents and their results. On the back of each blank are printed diagrams of four typical road locations—a tangent, a simple curve, a reverse curve, and an intersection. The reports received daily are recorded by colored tacks, each color representing a certain kind of accident, on a large map of the state road system.

In discussing the facts brought out by the study, Mr. Williar says, in part:

"One of the interesting developments is that the largest number of accidents have occurred at the places that have always been considered safe, while the sections of road which have been commonly regarded as extremely dangerous are proving to be relatively free from accidents. It is particularly noticeable that in western Maryland, where the state highway crosses the Blue Ridge, and where the grades are necessarily steep and the curves sharp, there have been but eight accidents in three months, none of which has resulted fatally. On other roads where numerous curves constitute what might be considered a decided hazard, the accidents have been few and not serious. Rather strangely also, the accidents have been fewest where the traffic density is greatest. Thus, on all the roads radiating from Baltimore, the three months' record shows only seven accidents within 10 mi. of the city, while in a similar zone around the town of Frederick, twice as many smash-ups occurred in the same length of time. Even the railway grade crossing, generally considered one of the most menacing of highway evils, has proved to be far from the most important cause of fatal accidents.

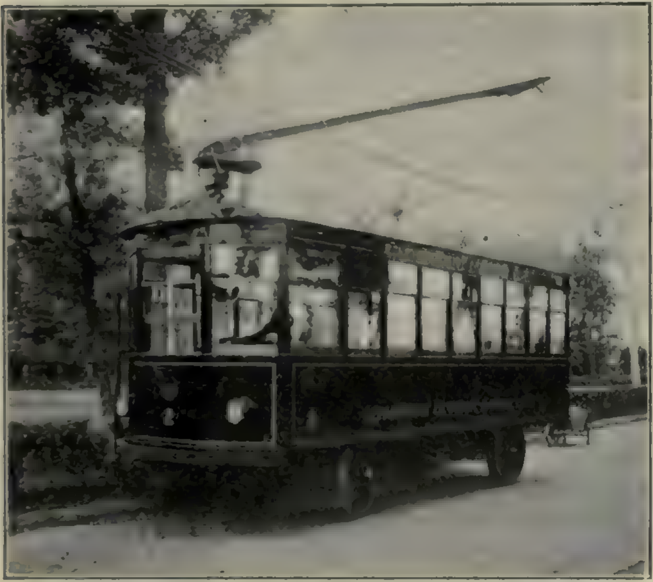
"The outstanding fact brought to light by the three months' record is that the vast majority of the disasters that overtake motorists are brought upon themselves by their own recklessness, and 90% are due to just one cause—speeding. On the National Pike, between Baltimore and Frederick, there are 48 mi. of the straightest road in the state. Few stretches of highway in the whole road system are so free from any features which might be considered dangerous. Yet the three months' record of this road is 16 accidents, 3 of which were fatal. Similarly, on the Baltimore-Washington Road, with all apparent danger spots removed, the record covering the same period shows that there has been 1 accident for every 4 mi. of road.

"There seems to be only one answer to account for these hitherto unexpected conditions. It is that even the less careful motorists drive cautiously in the presence of recognized dangers, such as steep grades, sharp curves, grade crossings, etc., while the absence of such dangerous features gives the driver a sense of security which prompts him to take a chance and yield to the passion for speed."

Trackless Trolley Line Established on Staten Island

The trackless trolley which is an innovation in the East, was put into operation recently on Staten Island, New York, in the presence of Mayor Hylan and other New York city officials. The new system will provide communication between the villages of Sea View and Meier's Corners and the heretofore rather inaccessible Linoleumville.

In appearance the trackless trolley is similar to the small one-man trolleys familiar to Staten Island with the exception that the wheels are surrounded with hard rubber tires and although electricity is the motive power, the operating mechanism is similar to an automobile's with steering wheel, clutch and foot and emergency brakes.



TRACKLESS TROLLEY ON STATEN ISLAND

VIEW OF INTERIOR OF THE CAR

C. T. Perry, Electrical Engineer of the Department of Plant and Structures designed for this system a car of greater stability than had been attempted hitherto, equipped with greater motor power and with all the safety appliances developed by experience in high-speed electric traction.

The electric current is supplied to the car by two overhead grooved trolley wires depending upon specially insulated hangers supported on span wires strung between poles. One wire is positive and delivers the current to the car. The other wire is negative, receiving the current passing through the motor and completing the circuit.

The productios of the power by the City is a feature of the operation. By certain additions to the equipment of the power plant at Sea View Hospital it was found possible for the city to generate the power instead of purchasing the current from a private plant. This current, at 550 volts, is carried to the trolley wires by a feeder cable.

The car consists of a steel frame body with "Steelosote," panels mounted on a chassis frame on which are supported by two h.p. 600 volt motors arranged for series parallel control. These motors are mounted on a single shaft and drive the car through a worm gear of special pitch mounted on the rear axle. The wheels are of the American cushion type with solid rubber non-skid tires.

The current is delivered from the overhead lines to the motors by means of a sliding contact supported on a single pole. This pole is divided electrically into two sections, contact being had through one section with the positive wire and through the other section with the negative wire. The pole is supported on a ball-bearing base which allows such free play to the pole that the car can swing 9 ft. 6 in. from the center line of the wires without losing contact with them. At the base of this pole is a hand maneuvering device by which the operator can raise or lower the pole or swing it from side to side to meet varied operating requirements, without leaving the car. Springs furnish sufficient tension to insure suitable contact pressure between the pole head and the wires. The car is operated by a man seated at a steering wheel. The first contact point for operation is obtained by a foot movement, and acceleration is had by hand movement. A combined foot and hand-braking effect enables the operator to start the car easily without jar and to stop without sudden effort in case of emergency.

The interior of the car, finished in white enamel, is equipped with spring cushion leather covered seats for 30 passengers, with a center aisle that affords ample room for 15 standing passengers. The car is equipped with two lighting circuits, one circuit taking current from the trolley wires, the other from a storage battery which is charged by a generator mounted on the forward end of the armature shaft. A low potential relay cuts into circuit the emergency lights when the pole leaves the trolley wire.

The springs used in the construction of the car, of high-grade silicon-manganese steel, with the spring cushions, give the car the riding qualities of a first-class automobile.

The car can easily maintain a speed of from 20 to 25 mi. per hour on a level road.

The cost for single track trolley construction per mi. varies from $37,000 to $60,000, according to the nature of the roadway that has to be torn up and relaid. The cost for trackless construction is approximately $4,000 per mile. The trolley system destroys the roadway; the trackless system does not. Its wear and tear on the roadway is no more than that due to automobiles.

"We have studied out all the elements of cost, including initial investment, maintenance, depreciation and operation," according to Mr. Perry, "and have found that the cost per car mile of the trackless system figures less than the cost of one-man trolley operation and less than the cost of gasoline buses. The figures are as follows:

Standard safety car, per car-mile	24.3
Gasoline bus	29.55
Trackless trolley car	20.95

"The Department believes, therefore, that in installing these trackless trolley systems on Staten Island, the city is inaugurating a method of transportation that will make possible the rapid and economical development of the outlying portions of the city and that will be found of immense practical value in enabling the city to clear its streets of the rails that now encumber them."

National Old Trails Road Celebration

The City of Greenfield, seat of Hancock County, Indiana, and birthplace of James Whitcomb Riley, will celebrate, October 29, the opening of the completed paved road between that city and Indianapolis, a distance of 21 mi. The Hoosier Motor Club is preparing to erect a number of needed danger signs along the route. The highway Commission has seen to it that heavy guard railings are erected at many embankments.

"This is but another link on the National Old Trails Road which eventually will be hard-paved across the Nation," stated Secretary Noblet of the Motor Club. "Our organization believes the Old Trails Road should be made a national memorial highway under federal direction and is working to that end. It is the Main St. of the nation and is much more entitled to be known as a memorial highway than any other."

Speed of Motor Trucks

How large is the average truck and how fast does it travel?

This question and others of interest to truck owners and users of the highways are answered by information obtbained in a recent traffic census taken by the U. S. Bureau of Public Roads, on one of the most traveled highways in New England. The census discloses that 40% of the trucks were of 1 ton capacity or less; 33% between 1 and 2½ tons; 5% between 2½ and 5 tons; and that less than 2% of the trucks were of more than 5 tons capacity.

On a level stretch of road, over which the speed of motor vehicles was timed, it was found that more trucks traveled at a speed of 20 mi. an hour than at any other rate. Thirty-seven per cent traveled 20 mi. an hour or faster. One truck, whose driver said he was in a hurry to get there, was found to be traveling at a speed of 45 mi. an hour.

War Explosives Used by State in Highway Work

Nearly 20,000,000 Pounds of TNT Included in Surplus War Materials Furnished to State Highway Department

Trinitrotoluol, one of the most efficient of war-time explosives, has become by adaptation, one of the most desirable agencies for the peace-time task of road construction, according to reports received from many state by the Bureau of Public Roads of the United States Department of Agriculture. The use of this powerful explosive is becoming general throughout the Union wherever highways are under construction. Out of the surplus war materials turned over by the War Department to the Department of Agriculture and distributed by the Bureau of Public Roads, among the various states, approximately 20,000,000 lb. of T N T. has found its way to the road builders' supply houses. This is more than four times as much as the total of powder of all grades distributed by the department among the States.

The quantity of T N T. distributed up to Sept. 15 among the states was 19,613,952 lb. In addition there has been distributed 1,798,988 lb. of blasting powder and 2,781,313 lb. of hand grenade powder. Among other materials of this nature distributed among the states were 6,566 lb. of dynamite, 267,600 lb. picric acid, 938,409 detonators, 131,674 exploders, 75,968 electric blasting caps, 27,840 ft. of fuse, 7,340 yd. of detonating cord, and 198 **tampers.**

The Effect of Tax Limits on County and Municipal Bonds[*]

By CHESTER B. MASSLICH

It is not always the size or wealth of a county or city which determines the salability of its bonds. And among the factors that determine the salability of municipal bonds, including in that term bonds of counties and taxing districts as well as of cities and towns, none is more important than a provision for unlimited taxes for their payment. The difficulties met with in marketing many public securities can be traced directly to a tax limitation.

A few years ago, when the demand for public securities was greater than the supply, less attention was paid by investors to the unfavorable features of many of these bonds. In these latter days, with millions of Liberty bonds outstanding, and a demand for money that cannot be supplied, discrimination has come to be used in the selection of investments, and this discrimination has directly affected municipal bonds that are not protected by an unlimited tax provision.

Tax limitations for current expenses and for permanent improvements are a necessary protection against burdensome taxation, but tax limitations affecting the payment of a debt legally created are utterly illogical. The taxpyer can be protected against an excessive public debt by a constitutional or statutory limitation upon the amount of the debt which may be legally created. Many states have such debt limitations in their constitutions and many others have fixed them by statute. These limitations protect the bondholder as well as the taxpayer, but there is no greater unwisdom than to limit the amount of the tax which may be collected to pay a debt lawfully created.

So vital has this appeared to lawmakers that a dozen or more of the states of the Union have written into their constitutions a mandatory requirement that no debt shall be created by any political subdivision unless then or theretofore provision shall have been made for the levy of a sufficient tax for its payment. In many of the other states statutory authority is given to levy a sufficient tax, but there are still many states in which the amount that can be levied annually to pay bonds is limited.

The number of these latter states is being gradually reduced. In some of them, where special and private acts are still permitted, the tax limitations of general laws are being set aside as to particular districts and localities.

The haphazard nature of these tax law is well illustrated in the State of Florida, where the constitution imposes no limit upon taxes for county bonds for any county purpose, but fixes the maximum annual rate for school district bonds at 5 mills on the dollar. As a result, Florida counties can sell bonds even in excessive amounts, while school districts suffer from their inability to borrow small sums.

North Carolina is one of the states which have seen the error of limits upon bond taxes. With few exceptions, all the general and special laws passed in that state in recent years granting authority for bond issues, have expressly provided that the tax for their payment shall be unlimited. South Carolina has followed the same new policy. Georgia has long since removed all limits upon bond taxes by constitutional enactments which make mandatory a sufficient levy without any limit whatever, and as a result the bonds of Georgia counties and municipalities find a ready sale. Georgia's taxpayers have not suffered, for the same section of the constitution which requires the unlimited tax puts a rigid limit upon the amount of lawful debt that may be created.

Across the line from Georgia, Alabama still labors under a constitutional limit of bond taxes, with the result that investors pay little attention to public securities coming from that state.

It must be remembered that a tax limit which appears to be sufficient at the time of the issuance of a public security, may presently become insufficient. Alabama has had exactly that experience. Assessed valuations change from year to year. Sometimes they change because property values have increased or decreased, but in many states they have changed by fiat of the Legislature, which has established a different basis of taxation and a different ratio between actual values and assessed values. Investors are well acquainted with the fact that these changes have sometimes been made on a downward scale. In Kentucky, where a constitutional limitation of bond taxes still prevails, a school district issued a comparatively small amount of bonds when its assessed valuation was about $1,500,000. Long before those bonds fell due, it became unprofitable further to develop the natural resources that had given the district its prosperity, and the assessed valuation fell to about $375,000. The 50-ct. tax rate allowed by the state constituiton would no longer produce the amount necessary to pay the interest and provide for a sinking fund, and the bondholders were compelled to compromise. Many such illustrations can be given in many states. In one prosperous Alabama city, where no question was raised as to the legality of any bonds it had issued, the authorities were able to effect a compromise which gave the bondholders new bonds at half the face value of the outstanding bonds and at only 3%

(Concluded on page 208)

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[*] From "Public Roads" for September 1921.

GOOD ROADS
CONSTRUCTION TRANSPORTATION MAINTENANCE

Founded January, 1892

E. L. POWERS
Editor

T. A. HULBERT
Managing Editor

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Cable Address: Gudrodes, New York

Copy for advertisements must reach the New York office by noon on Tuesday of the week before date of issue if proofs are to be submitted.

Copy for classified and other advertisements where proofs are not required will be accepted until noon on Monday of the week of issue.

Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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Vol. LXI. October 26, 1921 No. 17

The Economic Problems of the Highway Engineer

With the expansion and development of highway work in this country there has come about a marked change in the character of the problems of the highway engineer. When the good roads movement was new technical problems were paramount. They are still pressing, but economic problems have become more and more important until today they are by far the most perplexing and intricate with which the highway engineer has to deal.

The primary reason for this change is, of course, the phenomenal development of motor truck transportation, of both passengers and commodities. Just beginning to be a factor when the World War came, motor transportation during the war period not only supplemented, but, in a measure, supplanted railroad transportation when the rail carrier all but broke down under their over-burden. As a result, the end of the war found the motor vehicle firmly established as a transportation medium—one with almost unlimited possibilities for the future, moreover.

The consequent change in the demands upon the highways brought construction and maintenance problems, as a matter of course. It also brought new economic problems and greatly magnified the old ones.

These economic problems are as varied as they are numerous; an examination of the news of the road field indicates both their numbers and their complexity. For instance, variations in the labor and material markets raise the question of when to award contracts —a strictly financial problem. Similar questions arise in connection with the fall letting of contracts. The whole question of taxation and bond issues is another economic matter that is within the province of the highway engineer. The selection of pavement type is another, and the determination of the justifiable expenditure for the repair and maintenance of a given pavement is yet another. The list might be extended almost indefinitely, but the few instances given are sufficient to indicate the nature of the problems that arise.

These new functions of the highway engineer—and what is true in the highway field is also true to a greater or less extent in other branches of engineering—have had their reaction upon the engineering schools. Educators are aware of the trend and are making earnest efforts to broaden engineering courses and to include in them a study of business and of finance. The old conception of the engineer as a more or less impractical theorist is fast giving way to the modern idea that he should be a capable executive and a good business man as well as a competent designer and constructor.

This is as it should be, for the engineer can not attain the highest success, nor can he render the greatest public service, by being merely an able technician.

New Jersey to Eliminate Roadside Signs The State of New Jersey is to make a start on the elimination of advertising signs along the roads of the state highway system, according to a recent report. This is a step that will be welcomed by the traveling public, for, as is pointed out by State Highway Engineer Wasser, the signs not only are eyesores, but are frequently sources of danger.

Trackless Trolley in New York City A trackless trolley line has been established on Staten Island, which constitutes the Borough of Richmond, New York City. Exterior and interior views of the type of car used are shown in this issue in connection with an article describing the installation. While it is probably too much to expect that much can be learned of the economics of this particular transit method from municipal operation in New York City, the line should afford an opportunity for the study of the mechanical problems involved.

Motor Transport's Opportunity A serious railroad strike seems at this writing to be among the possibilities of the near future. If it does come, the motor truck will be afforded an unprecedented opportunity to further demonstrate its essentiality in the nation's commerce and industry. No one who has followed the development of highway transportation during the past few years can doubt the ability of the truck to meet the test. If there is any failure, it will be due to the human equation in the problem of organization to meet the emergency.

Pennsylvania State Highway Department Plans Motor Vehicle Registration

Application for 1922 automobile licenses may now be made for delivery, which will take place soon after Nov. 1, according to advices coming from the State Highway Department of Pennsylvania.

Owing to the volume of mail handled during the holiday season, the State Highway Department, it is announced, cannot guarantee delivery of automobile licenses by Jan. 1, 1922, on applications received Dec. 1, and for this reason it is urged that applications be made at an early date.

To Remove New Jersey Roadside Signs

Work will be started in the near future on the removal of all advertising signs from the New Jersey state highway system, as authorized by Chapter 131 of the laws of 1917.

The State Highway Commission sanctioned the removal of the signs after State Highway Engineer Wasser had called attention to the manner in which the law was being violated, and in so doing advised that many of the signs besides being eyesores are objectionable in that they tend to distract attention from highway signs placed as a guide or as a warning respecting points of danger.

Registration Receipts of Motor Vehicles Increase

A total of 9,245,195 passenger automobiles, trucks, and commercial vehicles, 28,114 trailers, and 177,234 motorcycles were registered in the 48 states and the District of Columbia during the first six months of the present year, according to the Bureau of Public Roads, U. S. Department of Agriculture. As a result of these registrations and the licensing of drivers, the states and the District collected, during that period, a total gross revenue of $108,213,165. The figures show an increase of nearly $6,000,000 over the full year of 1920, when such revenues totaled $102,546,212.

"Of the 1920 registration revenues," says the bureau, "$97,671,742, or 95%, was available for road work. Of the registration revenues collected during the first six months of the current year, $101,793,416 is available for road work, either by the state highway departments or local road officials." The percentage of the gross during that period is 94—an apparent decrease of 1%, but the increase seems more apparent than real, because in some states the funds do not become available until the end of the year.

Ten state legislatures have imposed a tax on gasoline during the current year. They are Arkansas, Arizona, Connecticut, Florida, Georgia, Montana, North Carolina, Pennsylvania, South Dakota, and Washington. Prior to this year Colorado, Kentucky, New Mexico, and Oregon had levied such a tax. The State of Louisiana has written such a measure into its new constitution.

Road Work in Maine

During the present season the highway commission of the state of Maine has had under construction a total of 48 sections of road, representing a total mileage of 169.99. Of these jobs, one was begun in 1919, 23 in 1920 and 24 during the present year.

More than 68 mi. were started in 1920, some of which has been completed and is now open to traffic and the remainder will be completed during the present year. Of this, 14 mi. have been constructed of bituminous macadam and an equal amount of concrete. Nine of the jobs under construction for the present year are of bituminous macadam, with a total mileage of 52.77; two are of Portland cement concrete totalling 91.77 mi. Thirteen are of gravel, with a total mileage of 28.33. It is expected that about 75% of the work begun this year will be completed before the close of the season.

In addition to the foregoing work, there have been approximately 35 mi. of gravel surfaced road under construction under the provisions of the "Three Town Act." When all the items are taken into consideration it will be found that there will be added to the improved road system of the state this year about 380 mi. distributed in practically every city and town.

Recklessness at Grade Crossings

One Driver in Three Guilty, According to Test Made by the Pennsylvania Railroad

One in three automobiles and motorcycles approach grade crossings recklessly, according to a test made by the Safety First Organization of the Pennsylvania Railroad at a crossing on the Lincoln Highway in southern Pennsylvania, in an effort to prevent grade accidents. It is estimated that more than 7,000 deaths and injuries result yearly from such accidents.

The crossing selected for the observation is 600 ft. west of Fort Louden Station, on the South Penn Branch of the Cumberland Valley Division, where the view of the drivers going west is obstructed until they are almost on the tracks. For eastbound automobiles the view is somewhat better, but it, by no means, affords a clear lookout for approaching trains.

A stop watch was used by the observer who took the numbers of only those motor vehicles which approached the crossing at excessive speed. In a little more than two hours 34 license numbers were noted from the 99 cars which passed over the crossing. Of the 40 going east 14, and of the 59 going west 20, were observed to be carelessly driven. The average speed of the 34 cars reported was 25 mi. an hour and three were going at more than 30 mi. an hour.

In accordance with the policy of the Pennsylvania Railroad, each of the owners of the 34 vehicles was sent a post card warning him, not in a spirit of criticism, but rather with the view of conserving life, not to approach grade crossings rapidly or carelessly.

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Crusher Run

The New York State Road Builders' Association has sent out to its members a letter calling attention to the action of the railroads in proposing a 15% increase in freight rates on crushed stone, gravel, sand and slag, and enclosing a questionnaire calling for information on the amounts of those materials still to be delivered on unfinished contracts, the present rates, etc.

H. Naakagawa, of Tokyo, was a recent visitor at the offices of the State Highway Department. Mr. Naakagawa was sent to America by the Japanese Government to study concrete road construction and has inspected roads in California, Illinois, Pennsylvania, Massachusetts and Connecticut. He was taken over the Albany-Schenectady Road and the Bethlehem Center-Beckers Corner Road by one of the department engineers.

At the letting on Oct. 7 there were 194 bidders on 13 contracts. Donald J. Hoose, of Oxford, was the lowest of 36 bidders on the Afton-Bainbridge, Chenango County, contract, at $50,957.50. The engineer's estimate was $74,321.05.

There were 33 bids on a contract for the reconstruction of 6.77 mi. of road in Tioga County, the Dale Engineering Co., Utica, being low at $193,678.69. A 2.91-mi. repair contract in Cattaraugus County brought out 29 bids. The lowest was submitted by Ansel A. Howard, Fairport.

F. E. Ellis, Melrose, Mass., was low bidder on the Ticonderoga-Montcalm Landing contract in Essex County, with a bid of $144,171.50. The engineer's estimate was $161,640.50. The Malloy Construction Co., Schenectady, submitted the lowest bid, $80,045.82, on a reconstruction contract in Schenectady County for which the engineer's estimate was $90,610.70.

Armstrong & Trowbridge, Washingtonville, have become members of the New York State Road Builders' Association.

The reconstruction of the Albany-Schenectady Road will be completed this month. The pavement consists of two 9-ft. concrete strips with a 6-ft. macadam roadway between them. It is the first of its kind to be built in the Albany district.

Benjamin P. Wheat, for the past 17 years a member of the law firm of Brackett, Todd, Wheat & Wait, has severed his connection with that firm to become one of the members of the new firm of Ainsworth, Sullivan, Wheat & Archibald, with offices at Albany. Mr. Wheat takes the place vacated by Former State Highway Commissioner John N. Carlisle, who withdrew to become president of the Northern Utilities Corporation.

The improvement of the historic Cherry Valley Turnpike, once the main route from Albany to Syracuse and the west, will be completed early next year. Last August a contract for 10.58 mi. of road, between Cherry Valley and Canajoharie, was awarded to Michael H. Ripton for $339,268.60. Plans for reconstructing the Guilderland-Duanesburg and the Sloansville-Sharon sections of the road are being prepared and the contracts will be advertised at one of the winter lettings. The distance from Albany to Syracuse is about 120 mi.

Richard Hopkins, Fred E. Ellis and John H. Gordon are members of a committee of the New York State Road Builders' Association that has been in conference with representatives of insurance companies in regard to a reduction in the rates on compensation insurance. No conclusion has been reached and the matter is still under discussion. Members have been advised that on repair, resurfacing and reconstruction contracts they are entitled to a rate of $2.99, though many of them have been paying $3.60. They have also been advised that all who had had good experience in reference to accidents can secure a reduced rate by applying for an "experience rating" and that this does not constitute a favor by the local agent, but is a right that will be granted to any contractor if a review of his record by the rating board warrants it.

MEETINGS

Calendar of Coming Meetings

Oct. 24-28.—American Society for Municipal Improvements.—Annual Convention, Baltimore, Md. Secretary, Charles Carroll Brown, Valparaiso, Ind.

Nov. 14-16—City Managers' Association.—Annual convention, Chicago, Ill. Secretary, H. G. Otis, City Manager, Clarksburg, W. Va.

Nov. 16-18—National Municipal League—Annual convention, Chicago, Ill. Secretary, H. W. Dood, 261 Broadway, New York, N. Y.

Jan. 17-20, 1922—American Road Builders' Association.—Nineteenth Annual Convention, Twelfth American Good Roads Congress and Thirteenth Good Roads Show under the auspices of the A. R. B. A., The Coliseum, Chicago, Ill. Secretary, E. L. Powers, 11 Waverly Place, New York, N. Y.

PERSONAL MENTION

G. R. Abney, of Beaumont, Texas, has been appointed highway engineer of Angelina County, Texas.

Former Division Engineer George McClellan has been appointed engineer of Harrison County, Texas, succeeding former State Highway Engineer George A. Duren.

John E. Johnson, of Paducah, Ky., has been appointed highway engineer for the western district of the state by the State Highway Department.

The Effect of Tax Limits on County and Municipal Bond Issues

(Concluded from page 204)

interest. Only one bond issue of that city escaped the general disaster, through the fact that it constituted a lien upon public property, and the bondholders took possession of that property under order of the United States courts.

The great insurance companies are among the heaviest investors in municipal securities. Long experience has taught them wisdom in these investments. Their attitude on the tax limit question may be illustrated by an occurrence within the past year. A syndicate of investment houses had purchased an issue of $2,000,000 bonds of a prominent city with a population of over 75,000 and contracted to sell this issue to four of the large insurance companies. One after the other, all acting independently, the counsel of these four companies raised the objection that there was a limitation upon the amount of tax the city might legally levy for the payment of the bonds. Three of the counsel were finally persuaded that the limitation had been repealed and their companies accordingly accepted the bonds. But the counsel of the largest of the four companies was unable to resolve his doubt as to whether the limit had been repealed, and accordingly declined to accept the bonds. And yet that city has a perfect record of prompt payment of princcipal and interest of its indebtedness.

An innocent purchaser of public securities is protected by the courts from many irregularities in their issuance. He is never protected against the evil consequences of a tax limit. There are commuinties in the United States which, abhorring the very thought of repudiation, have nevertheless been compelled to repudiate and compromise because the maximum limits of taxes they were permitted to levy have not been sufficient to meet their debts. One of the greatest American cities suffered that dishonor, but rose in its might and demanded and obtained a constitutional amendment for itself alone, empowering it to levy sufficient taxes to pay its creditors. It was many years however, before it could outlive the effects of that dishonor. The laws permitting investment of funds of savings banks in New York and the various New England States, make it a condition of such investments that no default shall have occurred within a given long period. Investors remember these defaults. They are sensible of the reasons why the defaults occurred and they are not anxious again to put themselves into a position which makes the payment of their bonds dependent upon the continued prosperity of the city or county which issued them.

Perhaps the worst form of tax limitation is the general limitation which fixes the maximum rate of annual tax for all purposes. If the amount raised by such a tax is insufficient to pay running municipal expenses and also the principal and interest of outstanding bonds, the courts hold that the payment of running expense comes first, and that the creditors can have no part of the taxes which the municipal authorities in their discretion choose to apply to those expenses. In other words, the maintenance of the life of a municipality is its first duty and the courts will not disturb the judgment of its governing body as to the amount necessary for maintainance.

There are many laws on the statute books today which fix so high a limit upon the amount of bonds which may be issued, and so low a limit upon the amount of taxes that may be levied to pay them, that it is a foregone conclusion that the bonds will not be enforcible if the entire amount allowed by law be issued.

Those who are interested in the building up of communities by road construction should see to it that their representatives in the legislature become acquainted with the conditions that will enable money to be borrowed for those purposes, and especially with the primary condition, now in almost universal demand by investors, that all tax limitations for the payment of municipal bonds be repealed.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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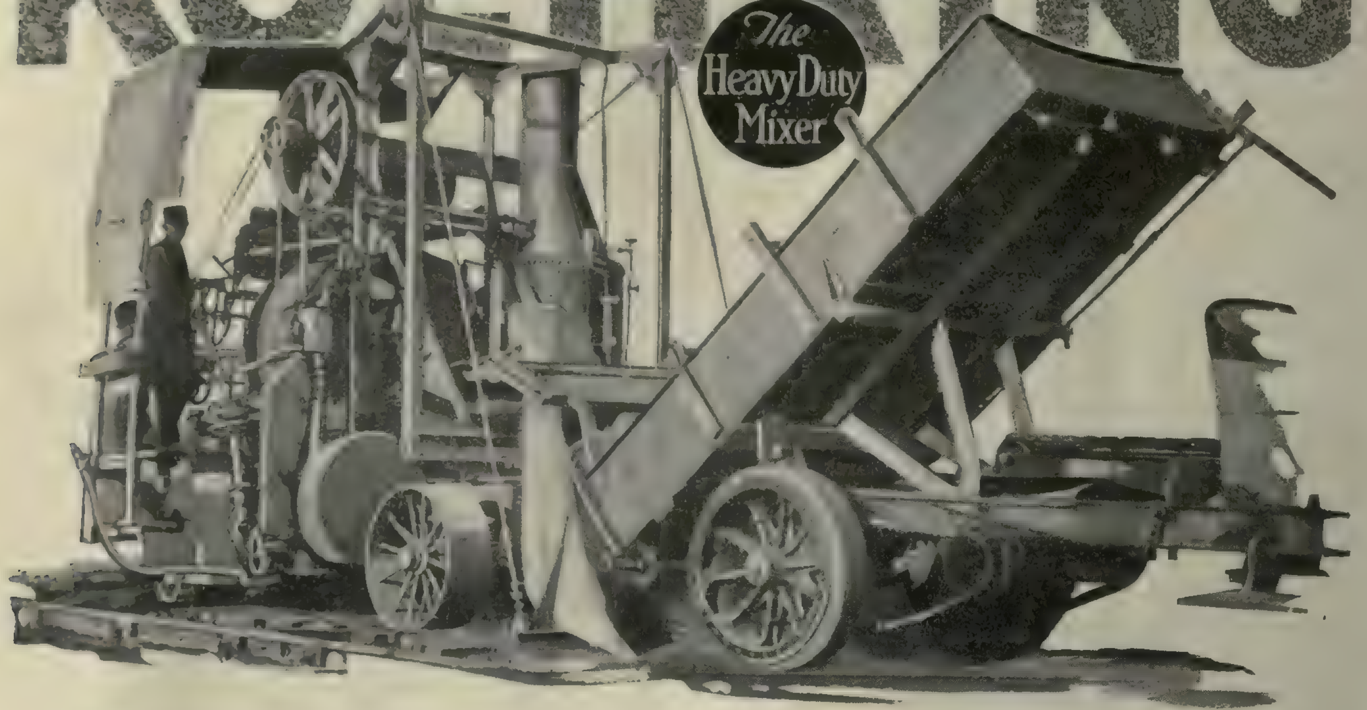

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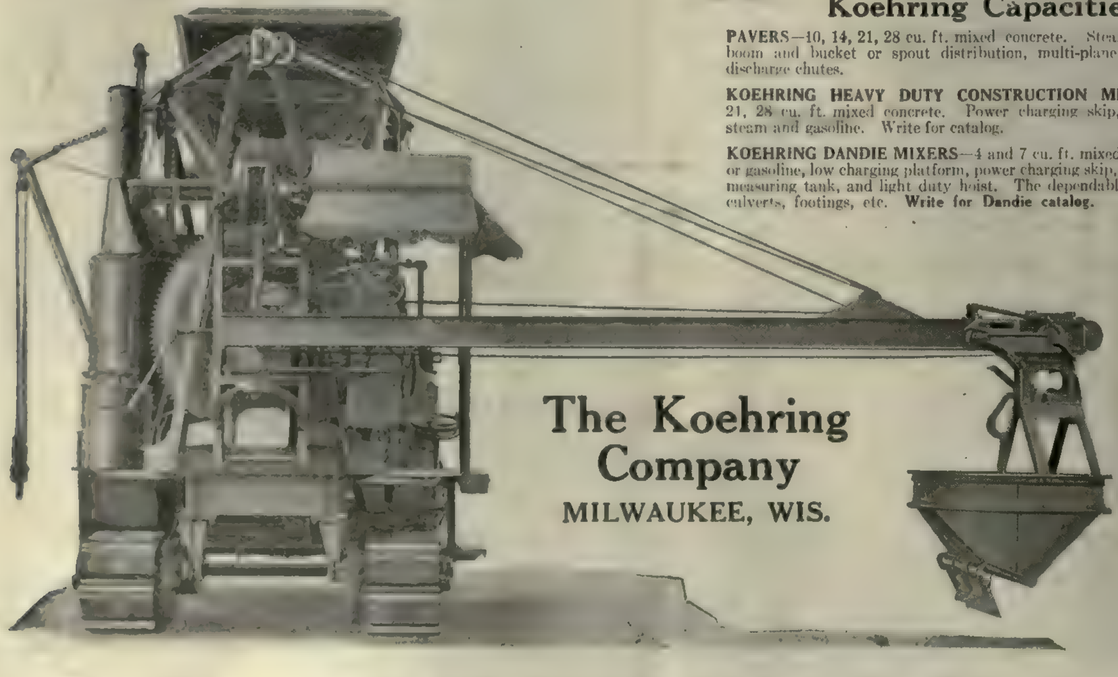

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WITH WHICH IS INCORPORATED

THE HIGHWAY CONTRACTOR AND ROAD BUILDER

Vol. LXI. NEW YORK, N. Y., NOVEMBER 2, 1921. Number 18.

Illumination and Traffic Accidents*

BY EARL A. ANDERSON AND O. F. HAAS†

The seriousness of accident hazard on streets of American cities as a factor to be reckoned with in every-day life becomes evident from even a casual inspection of statistics which show the losses incurred in this continuous waste of life, time and property. For example, in a recent paper Simpson‡ gave figures showing 25,000 fatal industrial and 2,000,000 total industrial accidents annually causing lost time of a total cost of $2,000,000,000 or a cost averaging $1,000 per accident. The total annual fatal accidents from all causes, including industrial, are estimated to be 75,500 from statistics compiled by Dr. Crum§, and of these approximately 7,800 are railway and 15,500 are street traffic accidents. Therefore, the loss of life in traffic accidents is twice as great as in railway accidents and equal to over half the total industrial loss.

As to an evaluation of the annual personal and property loss from automobile accidents in terms of money, Dr. Crum states that while an accurate computation is not possible, the annual sacrifice is fully $1,000,000,000. This figure appears very reasonable

THE SCHENECTADY-ALBANY HIGHWAY AT NIGHT—LIGHTED BY NOVALUX HIGHWAY UNITS when one considers that in the survey of traffic accidents numbering 800 fatalities reported in this paper there are 31,000 other accidents of sufficient severity to be reported to the police and that personal injuries were sustained in approximately one-half of these cases.

---

*Paper presented at the annual convention of the Illuminating Engineering Society, Rochester, N. Y., Sept. 26-29, 1921.

†Engineering Department, National Lamp Works, General Electric Company.

‡R. E. Simpson, Travelers Insurance Co.—I. E. S. Transactions, Vol. XV, No. 8.

§F. S. Crum, Statistician, Prudential Insurance Co., Automobile Fatalities.

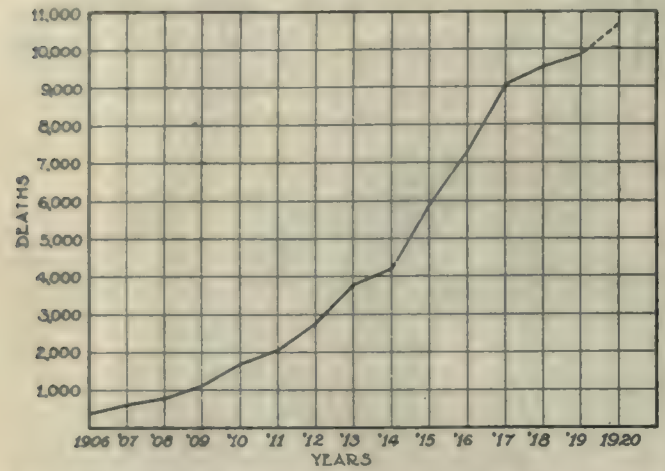

FIG. 1.—DEATHS FROM AUTOMOBILE ACCIDENTS, BY YEARS

To the development of high speed traffic brought about by the very extensive adoption of automobiles must be charged practically all of the increase in street traffic accidents. In 1906 there were less than 400 deaths in the United States from automobile accidents, while in 1920 the total was greater than 10,000 representing an increase of 2,500%. Further, as shown by the curve of Fig. 1, this total is mounting steadily. In recent years efforts have been directed toward reducing the accident rate by more stringent traffic regulations and by widespread educational publicity work on the part of safety organizations. Definite evidence of the value of such safety measures may be seen in statistics which show a check in the growth of the accident rate in those cities and localities where the most careful attention has been given to the development of accident prevention efforts.

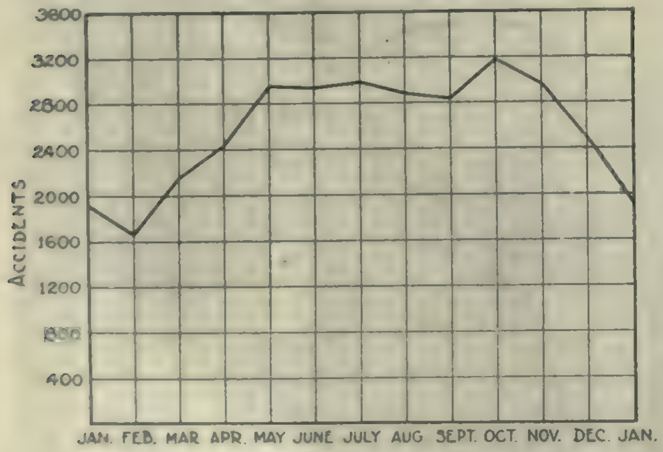

FIG 2—TRAFFIC ACCIDENTS, BY MONTHS

The figures presented by Dr. Crum show that at least two-thirds of all traffic accidents have occurred in cities of 10,000 inhabitants or more and on this basis it would appear that the traffic accident problem is of greatest immediate importance in these larger communities. It is worthy of note, however, that the increasing amount of inter-city touring has brought a heavy highway traffic to villages of even the smallest size and it is, therefore, apparent that even in smaller communities public safety demands an increased attention toward means for reducing the street traffic accident hazard.

The purpose in instituting the survey reported in this paper was to obtain, if possible, some definite measure of the value which should be attributed to the proper illumination of streets as a factor in the prevention of traffic accidents. In order to obtain as high a degree of uniformity as possible in the collection of the data, blank forms were prepared providing for a charting of all traffic accidents in a given city during the period of one year and for distributing them as to the month and hour of the day at which each occurred, with notations as to whether or not the accident resulted in a fatality. A representative group of cities was selected and individuals in each who were known to be interested in problems of public safety were requested to arrange for the tabulation of the data. The work of tabulating accidents from the city records was often tedious on account of the way in which the accident reports were filed. In some instances the accident data were not available. The very cordial response to the request for cooperation in this survey is, however, attested by the fact that tabulated reports in form to be directly applied were obtained from 32 cities with a combined population of over 7,000,000. From each of these cities the report covered a full year's accidents; in most cases during the period from the middle of 1919 to the middle of the year 1920. The names of the cities and an abbreviated summary of the data for each city are given in the accompanying tabulation.

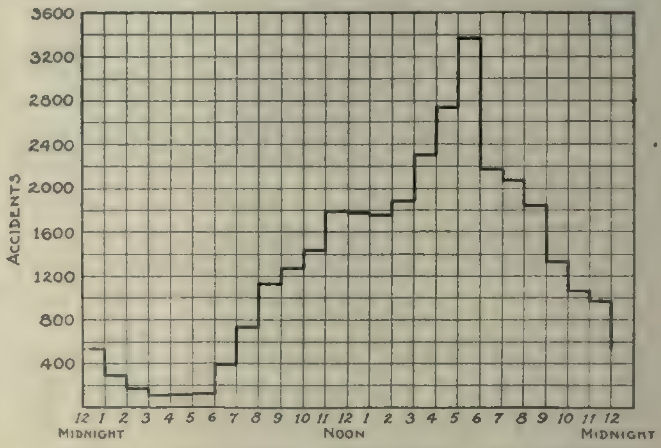

FIG. 3.—TRAFFIC ACCIDENTS, BY HOURS

The total number of street traffic accidents reported for one year in these 32 cities was 31,475, of which 9,534 or 30.3% occurred during hours of darkness. It was anticipated that there might be considerable variation in conditions existing in individual cities located in different states and it was, therefore, particularly desired to obtain a sufficiently diverse group of cities including a large enough total of population to give the presumption of a reasonable degree of accuracy in the results.

The 31,475 traffic accidents are charted in Fig. 2, according to the total number during each month. In certain cities special local influences, such as an excess of traffic at some one season of the year, changed the distribution of accidents considerably but in most cases the individual reports adhered to the trend shown by the average curve in Fig. 2. At first thought it is somewhat surprising to note that there were a greater number of accidents in the summer months than in winter as there are a number of influences which tend to increase the hazard in winter, such as stormy, foggy weather, slippery streets, and the impediment of heavy clothing. However, as a matter of fact, the traffic is so much greater during summer months than in winter that even in spite of the unfavorable conditions in winter the accidents are more in the summer than in the winter months in most cities.

TRAFFIC ACCIDENT STATISTICS FOR THIRY-TWO CITIES DURING A PERIOD OF ONE YEAR.
TRAFFIC ACCIDENTS REPORTED.

	Total	Night	Total Fatal	Night Fatal	3—5 p. m. Winter*	3—5 p. m. Summer	9—11 p. m. Winter*	9—11 p. m. Summer	6—8 p. m. Winter*	6—8 p. m. Summer
Philadelphia, Pa.	5231	1485	190	66	175	251	71	98	164	183
Cleveland, Ohio	3549	1059	174	56	120	120	89	73	154	121
Boston, Mass.	3380	1001	89	38	108	159	57	69	117	131
Pittsburgh, Pa.	2950	982	6	2	119	183	57	100	74	109
San Francisco, Cal.	3014	1092	76	32	127	106	58	73	110	84
Jersey City, N. J..........	672	223	28	13	18	38	8	17	36	32
Rochester, N. Y.	2570	735	29	9	70	111	34	71	62	119
Portland, Oregon	1230	411	31	8	45	43	11	21	38	48
Columbus, Ohio	193	95	17	9	7	11	6	13	.8	7
Hartford, Conn.	1389	300	19	6	38	72	12	17	37	57
Grand Rapids, Mich.......	255	78	12	4	9	8	1	7	10	12
Youngstown, Ohio	702	258	33	15	33	31	12	17	28	25
New Bedford, Mass.	699	189	7	3	34	40	6	.17	20	31
Lynn, Mass.	818	278	7	2	35	40	19	20	36	42
Utica, N. Y.	652	150	8	3	22	43	2	25	16	33
Fort Wayne, Ind.	1010	241	9	2	42	30	14	13	29	19
Peoria, Ill.	131	26	7	3	5	11	1	1	5	1
South Bend, Ind.	143	46	6	3	6	6	5	6	7	5
Portland, Me.	620	177	1	—	16	24	9	16	20	18
Charleston, S. C.	192	52	13	3	6	8	—	7	8	3
Rockford, Ill.	181	45	11	3	5	15	3	5	3	9
Saginaw, Mich.	120	48	3	—	—	7	2	3	8	5
Holyoke, Mass.	287	79	5	2	15	13	5	2	5	15
Gary, Ind.	281	78	10	4	5	11	3	13	6	12
Malden, Mass.	187	56	3	—	3	9	—	5	3	13
McKeesport, Pa.	74	30	2	—	1	1	1	3	2	6
New Castle, Pa.	74	31	3	1	3	2	—	5	2	12
Mt. Vernon, N. Y.	264	78	2	1	11	12	3	7	8	12
Evanston, Ill.	287	81	5	4	7	17	2	7	6	11
Austin, Texas	169	75	2	2	9	3	2	2	16	9
Muskogee, Okla.	42	20	2	—	—	3	1	1	2	9
East Cleveland, Ohio.....	109	35	6	4	1	1	1	6	6	7
Total................	31,475	9,534	821	298	1,095	1,429	495	740	1,046	1,200

*Winter refers to November, December and January. Summer refers to May, June and July.

The total accidents reported for the year are charted in Fig. 3, according to the hour of the day during which they occurred. This chart also shows the apparent importance of density of traffic as a factor in causing accidents. It will be noted that relatively few accidents are reported in the hours from 1 to 7 a. m., the period of the day in which street traffic is least. On the other hand, the accident rate becomes greatest in the hour from 5 to 6 p. m., when in practically every city the streets are congested with the home-going population from offices, stores and factories.

An obvious and simple way of determining how many of the 9,534 accedents which occurred after dark would have been avoided had daylight or its equivalent been available, is to compare the accidents which occurred during the hours in the evening which were daylight in summer with the number of accidents which occurred during the same hours in winter when because of the shortness of the day it was dark. Consultation of tables of sunrise and sunset applying to the different cities involved indicated that the hours 6 to 8 p. m., were the two hours of the day which are fully light in the months of May, June and July and entirely dark during the months of November, December and January.

It is evident, however, that a ratio between the accidents occurring from the hours 6 to 8 p. m. in summer as against the number that occur during the corresponding hours in winter would not directly show the influence of light because of the numerous other variables referred to above which have an influence that must be taken into account.

Fortunately the accident statistics for the hours of the day which are light in both summer and winter or which are dark in both summer and winter offer a convenient means for determining a correction factor to take into account the variables other than light which affect the number of traffic accidents in winter and summer. The periods of 3 to 5 p. m. and 9 to 11 p m. are the logical selection because of their adjacency and the consequent similarity of traffic to that in the 6 to 8 p. m. period. In the accompanying tabulation are shown the data on accidents by cities and the totals for the respective periods of 3 to 5 p. m., 6 to 8 p. m. and 9 to 11 p. m., separated so as to show the number of accidents during these hours in the "summer" months of May, June and July, and the "winter" months of November, December and January combined.

Referring to the totals in the tabulation, and taking first the hours from 3 to 5 p. m. which are daylight in both summer and winter, the number of accidents are found to total 1,429 in summer and 1,095 in winter. The winter accidents from 3 to 5 p. m. are, therefore, 76.6% of the summer total. Considering next the totals for the period of 9 to 11 p. m. which is dark both in summer and winter, it is noted that the accidents are respectively 740 and 495 The winter accidents from 9 to 11 p. m. are, therefore, 66.9% of the summer total. If these two percentages of 77.6 and 66.9 are averaged it is indicated that for the group of cities in this survey, traffic conditions are such that excluding the influences of illumination the winter accident rate in the afternoon and evening is approximately 71.8% of the summer accident rate.

Considering next the period of 6 to 8 p. m. which in summer is daylight, there is shown a total of 1,200 accidents in the 32 cities during the three months of May, June and July. Hence, applying the average percentage of winter to summer accidents (71.8%) determined as above[*] it would be anticipated that in the three "winter" months of December, January and February, there would be 862 (71.8% of 1,200) accidents during the hours of 6 to 8 p. m. However, the survey shows a total of 1,046 accidents to have actually occurred during these hours in the three winter months or 184 more than anticipated provided there had been the same effectiveness of illumination in the winter months as in summer. Hence, there is the strongest evidence that 184 accidents or 17.6% of all those at night must be attributed to the lack of light during the winter months. Applying this same percentage to the 9,534 accidents which occurred after dark in the 32 cities covered by this survey it appears that 1,678 would have been avoided if adequate illumination had been provided.

Assuming that the same proportion of day and night accidents which was found to exist in this survey holds in all cities, last year there must have been out of the total of 10,640 killed, 3,223 deaths from night automobile accidents and 17.6% of these, or 567 were, therefore, directly attributable to lack of sufficient illumination. In addition to this loss of life a similar computation shows that the very substantial amount of $54,000,000 of the billion dollar annual street accident loss estimated by Dr. Crum may also be attributed to lack of light. According to census reports the total expenditure for street lighting in the United States is not in excess of $50,000,000.

The percentage of 17.6 arrived at as the proportion of night accidents which may be attributed to lack of light is undoubtedly an extremely conservative figure to use in evaluating the usefulness of illumination in preventing traffic accidents, for, as a matter of fact, the streets of all of the cities covered in the foregoing survey were illuminated at night by artificial lighting of varying degrees of effectiveness. In an individual city where the need for better street lighting is especially evident the percentage of night accidents chargeable to the lack of light is likely to run as high as 50%. On the other hand, in the case of those districts where fairly high levels of artificial street lighting are provided by so-called White Way systems, the percentage of night accidents chargeable to lack of illumination can be said to be fairly low. It was hoped to have data from this survey to show the difference but it was not found practical to separate the statistics for the better lighted sections in a sufficient number of cases to arrive at an average figure.

While in the present state of the art it is not practical to provide artificial street lighting approaching actual daylight levels it is entirely feasible to increase the quantity of light to a level from 3 to 10 times as high as that provided by average existing systems, and when this is done with properly installed equipment it may be confidently expected that a large measure of the benefit of light in reducing accidents will be secured.

It is, perhaps, pertinent to emphasize that these higher levels of artificial street illumination, the expenditure for which is so amply justified as an accident prevention measure, have many other important advantages in contributing very greatly to the prevention of crime, to the comfort and convenience of all those traversing the streets, and to commercial and industrial progress.

Modern illuminating engineering has been of great assistance economically in making possible "double shift" operation of industrial plants, thereby in many cases reducing the overhead charges on the investment in plant and machinery by as much as one-half. In the development of a level of street lighting such as will enable night traffic at the same density, speed, convenience and safety as by day, there is offered a similar important opportunity for community economy. Large as the expenditures are already for improved

(Concluded on Page 214.)

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[*] The percentage for 6 to 8 p. m. actually is probably nearer the 9 to 11 p. m. figure of 66.9% than the average of 71.8% since both periods are during the evening hours. However, the more conservative figure is used. Had 66.9% been used the computed percentage of accidents due to lack of light would have been 23.3%.

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CONSTRUCTION TRANSPORTATION MAINTENANCE

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Managing Editor

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Copy for classified and other advertisements where proofs are not required will be accepted until noon on Monday of the week of issue.

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Vol. LXI. November 2, 1921 No. 18

HIGHWAY ILLUMINATION

Rather startling figures on traffic accidents, with some interesting deductions as to the effect of illumination upon the safety of highways, are contained in a paper printed on other pages of this issue.

By means of a comparative study of street accident data from 32 representative American cities, the authors of the paper reach the conclusion that 17.6% of the accidents occurring at night are due to lack of light. They point out that all of the cities covered by the investigation are illuminated at night by "artificial lighting of varying degrees of effectiveness," and argue that in a city where the need of better street lighting is especially evident "the percentage of night accidents chargeable to the lack of light is likely to run as high as 50%."

It would be interesting to compare the data obtained by the authors with corresponding data from cities without street illumination, but presenting other conditions exactly the same. Naturally, any such comparison is impossible, no comparable cities being without street lighting systems of some kind. It might be practicable, however, to record accidents at unlighted rural crossroads with heavy traffic and then install lights and collect new data for comparison. It is quite possible that such a study would lead to a modification of some of the conclusions as to the dangers of darkness.

As a matter of fact, it is quite probable that the average street lighting system causes about as many accidents as it prevents. This is not an argument against real illumination, but against the usual system. It would be a fine thing to really light the highways, but the installations ordinarily found on country roads and the streets of small cities are more frequently hazards than safeguards.

Road Work in 1921 Though complete data are not at hand, the reports on 1921 road work that have been received indicate that the volume of work for the year is going to reach gratifying proportions. More and better roads are among the chief postwar needs of the nation. There can be little question that the states are building better and better roads. It also seems evident that conditions are fast returning to "normalcy" in respect to the amount of work done.

Motor Trucks Not to Be Drafted In a recent issue attention was called to the opportunity that would be afforded the motor truck to prove again its worth if the railroad workers carried out their intention to strike. At this writing the proposed walkout has been called off and it is evident that the plans to draft and mobilize the country's commercial motor vehicles will not have to be put into execution. But the motor truck, having come to stay, will continue its efficient service, supplementing the railroads on the long haul and supplanting them on the short.

Road Building in Mexico If the Mexican Government carries out its plans for the construction of a system of military roads, that turbulent country will take a long step towards peace and prosperity. Much of the government's weakness in dealing with insurrection and banditry is due to the lack of transportation facilities. With an area a little more than one-fifth that of the United States (not including Alaska and other possessions), Mexico has only about one-sixteenth of the railroad mileage of this country and an insignificant mileage of usable roads.

Engineering Education Since the training received by engineering students today will have so great an influence upon the engineering work of tomorrow, it would seem that organizations of road builders and engineers that are to meet during the coming months could profitably devote more time than they have been in the habit of giving to the discussion of courses of study in technical schools. Neither engineers nor educators are agreed upon all points, and each class, as well as the individuals in the two classes, might gain much from an interchange of views. One of the most fruitful subjects of discussion should be the extent to which specialization should be carried in undergraduate work.

Illumination and Traffic Accidents

(Concluded from Page 212.)

thoroughfares and highways, engineers estimate that at the present rate of traffic growth duplicate roadways must be built very soon in many districts. This congestion, however, will be greatly relieved and the time when duplicate road construction is required will be postponed for years in many cases provided a larger proportion of the traffic can be diverted from the crowded day hours. In line with this Mr. Arthur Williams, of New York, recently presented a paper in which reductions as great as one-half in trucking cost were estimated to be possible by the increased utilization of equipment and terminal facilities and the avoidance of traffic delays by the use of streets during the less congested night hours. It is apparent that the density of traffic which would result from such a "double shift" utilization of thoroughfares and highways would greatly increase the total of night accidents. Furthermore, the greater density of traffic at night would undoubtedly result in a larger proportion than 17.6% of the accidents being chargeable to lack of light, unless adequate street lighting is provided. But the annual cost to the community of lighting entirely sufficient for safe and convenient night traffic is small indeed compared with the construction and maintenance cost of the additional roadways which will otherwise be required. In conclusion the authors wish to acknowledge indebtedness to Mr. Ward Harrison for valuable suggestions in connection with the survey reported in this paper.

Automobile License Number System in New York State

The New York State Tax Commission has announced that 243,000 automobile license plates for passenger cars have been assigned to New York City for 1922. The plates will be numbered from 7,000 to 49-999 and from 590-501 to 790-500. With this information in mind, police, state troopers or others interested can tell at a glance that any car carrying any of these numbers next year was registered from New York City. Similarly, numbers included between certain limits have been assigned to the various counties outside the city.

State officials are of the opinion that this method of licensing automobiles will be of assistance in locating stolen cars and identifying violators of the highway or local traffic laws and regulations. Police and state troopers will be supplied with full information as to the distribution of the plates by the commission.

Commercial vehicles will be numbered 800-000 to 966-000, of which New York City will have the last 65,000. Omnibus licenses will run from 0-50000 to 0-86550, and the trailer licenses from 993-000 to 997-350, New York being assigned 0-71351 to 0-86550, and 995-851 to 997-350 respectively. Eleven thousand motorcycle numbers have been assigned to the metropolis, running from 22826 to 33825. The first 2,000 passenger car numbers have been reserved for state owned cars. Dealers' plates will be taken from the numbers running from 2-001 to 6-999.

Bridge at Mandan, N. D., Nearing Completion

The vehicle bridge across the Missouri river between Mandan and Bismarck, N. D., is being rapidly constructed according to recent reports. The first of the 3 steel spans, each 426 ft. long, has been completed, and all spans will be in position by Jan. 1, it is said.

The bridge will cost $1,250,000 and is being constructed through federal aid. It is planned to hold the semi-annual meeting of the North Dakota Chapter of the American Association of Engineers at Mandan at the time of the dedication of the bridge.

Proposed Chicago Bridge Bonds

Various civic organizations in the city of Chicago will hold a meeting in the near future to discuss the advisability of submitting two bond issues to the voters at a special election to be held next spring for the purpose of improving highways and bridges. The meeting will be in charge of Chairman John A. Richert, of the City Council Finance Committee.

If the voters should decide on issuing bonds, $2,000,000 would be used to complete the Roosevelt Road Viaduct and bridge and the other for $3,000,000 or $4,000,000 would be used for new bridges at Clark, La Salle, Adams and Van Buren Sts.

Large Texas Contract Let

One of the largest road contracts ever awarded was let recently at Midland, Texas. The project is 100 mi. long, reaching across four counties and involves the expenditure of nearly $1,000,000, of which $432,672 is state and federal aid. The completion of the project will have big influence in the development of resources in West Texas, and in the near future the Highway Department hopes to complete the remaining links in the Bankhead Highway, connecting Texarkana with El Paso.

With the award of this project following the recent awards in Reeves, Jeff Davis, and Hudspeth Counties, and the work under way in El Paso County, West Texas has now 200 mi. of highway under construction and 15 more soon to be let in El Paso County.

Automobile Fatalities in New York State during September numbered 213, according to a recent report of the National Highways Protective Society. Of this number 47 were killed in New York City. Trolleys and horse-drawn vehicles accounted for 13 and of the state total 25 persons lost their lives in railroad grade crossing accidents.

Equipment — Trade — Materials

Changes in Bucyrus Sales Offices

The Bucyrus Company, South Milwaukee, Wis., has announced several changes in its sales offices.

The New York City office has been moved to 30 Church St., Suite 728, and E. G. Lewis will take charge on Dec. 1. Mr. Lewis has been connected with the company for many years, both in the Chicago and the New York offices, and has also had a wide experience in general and railroad contracting work, in this country and abroad.

M. J. Woodhull has been appointed central sales manager to succeed Mr. Lewis and will have charge of the Chicago office at 622 McCormick Bldg.

E. R. Weber has been appointed northern sales manager, with headquarters at the Minneapolis office, 1224 McKnight Bldg., succeeding J. N. Gawthrop, who will be associated with Mr. Lewis in New York.

CREOSOTED TIMBER FOR USE IN HIGHWAY CONSTRUCTION

Treated Timber Approved by U. S. Bureau of Public Roads for Use Under Specified Conditions

Attention has been called to the recent action of the Bureau of Public Roads, U. S. Department of Agriculture, in instructing its district engineers to sanction the use of creosoted timber on federal aid road work under certain specified conditions.

Early this year the Bureau called to the attention of the district engineers the fact that under the abnormal conditions obtaining during the war period the Government had participated in the construction of many timber bridges on federal aid projects, but that with construction and transportation conditions again becoming normal, it was not the intention of the Bureau to continue such participation except where unusual conditions clearly justified it. The letter of instruction emphasized the point that it was not intended to absolutely prohibit the construction of substantial wooden structures, but that each case should be given consideration on its merits and wood used for bridges and trestles only when justified by economic considerations.

In September another letter of instruction was sent to the district engineers in which it was pointed out that while the policy outlined in the previous letter was to be adhered to, in those cases where the district engineer was prepared to recommend the use of timber the Bureau would not "question the use of creosoted material" where the following conditions were observed:

"(a) Timber trestles or bridges constructed of creosoted material treated by the vacuum and pressure method.

"(b) Timber floors constructed of creosoted planking treated by the vacuum and pressure method, laid laterally with a plain or tank treated wearing floor ('half sole'); or laid laterally or longitudinally on edge, spiked together, and covered with a mastic wearing course.

"(c) Timber floors, for light traffic, where single floors are laid and not protected by any covering constructed of tank treated material or plain material, depending upon whether plain timber is more likely to rot out or wear out."

The letter, in closing, pointed out that it was not to be construed "as an endorsement of this type of construction, or to let down bar to its general use, but to define procedure when conditions of traffic and economy require consideration of timber construction."

Champion Snowplow Catalog

An attractive catalog describing the "Champion" and "Climax" snowplows, the former a new and improved type, has recently been issued by the manufacturer, the Good Roads Machinery Co., Kennett Square, Pa.

The catalog consists of 32 pages and cover, and is printed in two colors. It illustrates and describes the various models of the plows, many of the illustrations showing the machines in operation. The illustrations are excellent halftones and the catalog is handsomely printed.

The Asphalt Association has announced the removal of its Chicago office from 29 So. La Salle St. to 729 Hearst Building.

The authorities of Travis County, Texas, recently purchased one 5-ton and three 10-ton Holt "Caterpillar" tractors for use in highway work. The machines were bought as the result of experience with three 5-ton machines in county road work.

The Chain Belt Co., Milwaukee, Wis., has announced the opening of offices at 735 Ellicott Square, Buffalo, N. Y. T. E. Cocker, who has been handling elevating and conveying equipment for the past five years, has been put in charge of the new offices as district manager of the territory served by them. Mr. Cocker will handle the entire "Rex" line manufactured by the Chain Belt Co.

The Austin Machinery Corporation, Chicago, Ill., has announced that Canadian Austin Machinery, Ltd., incorporated under the laws of Canada, will hereafter act as sole manufacturer and distributor in Canada of the entire Austin line of earth moving and concrete mixing equipment. The Canadian corporation is situated at Woodstock, Ont., a point that enables it to meet contractors' wants promptly, in service and maintenance as well as in sales.

MEETINGS

Calendar of Coming Meetings

Nov. 14-16—City Managers' Association. Annual convention, Chicago, Ill. Secretary, H. G. Otis, City Manager, Clarksburg, W. Va.

Nov. 16-18—National Municipal League. Annual convention, Chicago, Ill. Secretary, H. W. Dood, 261 Broadway, New York, N. Y.

Jan. 17-20, 1922—American Road Builders' Association. Nineteenth Annual Convention, Twelfth American Good Roads Congress and Thirteenth Good Roads Show under the auspices of the A. R. B. A., The Coliseum, Chicago, Ill. Secretary, E. L. Powers, 11 Waverly Place, New York, N. Y.

North Carolina Good Roads Association

Amending of the state constitution to relieve taxation affecting road building and other public improvements was urged at the 21st annual convention of the North Carolina Good Roads Association, held at Greensboro, N. C., on Oct. 10, 11 and 12.

The taxation question was discussed by H. G. Conner, Jr., of Wilson, whose name appeared on the state road law and who is also a member of the State Finance Committee of the General Assembly, and B. W. Parham, of Oxford, also a member of the current General Assembly and of its Finance Committee. They came to the conclusion that the constitution must be amended insofar as it affects the payment of principal and interest on bonds. The idea was also advanced that the state must place some limit on the amount of the bonds which a county may issue.

During the afternoon session it was reported that since its organization in April, the State Highway Department had expanded from a few hundred employees to thousands and arrangements had been made for the routing of a system of 6,100 mi. of highways in 100 counties of the state, in which there are 52,000 mi. of public roads. Deducting 6,100 mi. constituting the state system, there remain 46,100 mi. to be improved by the counties.

The convention was attended by 133 delegates from 33 counties, representing members of the State Highway Commission, county engineers, county commissioners, county road commissioners, representatives of road material and machinery companies, contractors, members of the General Assembly, representatives of women's clubs and citizens at large.

R. A. Burnett, of New Hanover County, described the maintenance system and the use of Tarvia and granite chips on old limestone macadam roads. "Certain Aspects of Highway Traffic," was the subject of a paper by B. F. Heidel, Senior Highway Engineer of the U. S. Bureau of Public Roads, and "Resort Development in North Carolina as a Result of the State Highway Program," was the subject of a paper read by Leonard Tufts, owner of Pinehurst. Others participating in the program were: Dr. I. B. Morse, of Henderson County, and W. M. Jones, of the American Legion and Secretary of the Carolinas Automotive Trade Association, of Charlotte.

The following officers were elected for the coming year: President, W. C. Boren, Greensboro; Secretary, Miss H. M. Berry, Chapel Hill; Treasurer, M. E. Hogan, Chapel Hill; First Vice Pres., Chas. Wallace, Morehead City; Second Vice Pres., Leonard Tufts, Pinehurst.

Indiana Association of County Commissioners

An interesting program will be rendered at the Indiana state meeting of the Association of County Commissioners to be held at Fort Wayne, Nov. 9 to 11. Those having the program in charge say that a radical departure will be made as they claim that heretofore it has been customary to fill the program with speakers who talk on supplies and materials, in highway construction. It is their contention that the commissioners hear this phase discussed every day during the routine of business and that they are not particularly interested in hearing this same old story in the association sessions.

The program committee is not yet ready to make its announcement, but it is understood that men of national reputation will speak on business conditions, finances, unemployment and various other related subjects and that the questions concerning materials and supplies will be confined to the routine business of the convention. It is expected that the attendance will exceed any previous meeting.

PERSONAL MENTION

J. B. Mayes, formerly an engineer with the State Highway Department of South Carolina, has been appointed road engineer of Williamsburg County, South Carolina.

Charles M. Babcock, State Highway Commissioner of Minnesota, has been appointed regional director in Minnesota for the unemployment conference and has been notified to that effect by Secretary Herbert Hoover, Chairman of the conference. Commissioner Babcock was appointed by President Harding.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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Concrete Roads
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GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE
WITH WHICH IS INCORPORATED
THE HIGHWAY CONTRACTOR AND ROAD BUILDER

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Tree Planting Along Public Highways*

Beautification of Roadsides Given Little Attention in Efforts to Improve Maximum Road Mileage at Minimum Cost—Present Demand for Planting—Obstacles to be Overcome—Methods of Financing—Rapid Progress to be Expected in Near Future

By F. W. BESLEY†

Vast sums of money have been spent in recent years in building magnificent systems of public highways in the various states; and, in their desire to construct the most miles at the lowest cost, engineers have given little or no attention to beautifying the roadsides. In fact, they have generally regarded beautification as a separate project. Lately, however, there has developed a strong sentiment in favor of planting shade trees along the roads. Some states have passed laws providing for such work, but in most cases it is left to local initiative, with little or no financial support from the state. As a result, little systematic work has been done.

Many of the trees along roads wrre removed before improved, surfaced roads were regarded as necessary. With the coming of the good roads era and its demand for wide, improved highways to accommodate the increasing motor traffic, most of the remaining trees were cut down. Some of this destruction was made necessary by widening and grading operations, but many trees were sacrificed needlessly. Since then a reaction has set in and there is a demand for tree planting. What is needed is systematic planting whenever lines and grades are permanently established.

In undertaking any plan of tree planting certain conditions peculiar to the work must be given due consideration in order to insure success. In the first place traffic conditions—both present and probable future—must be given proper weight. This means that allowance must be made for widening sufficient to take care of the traffic safely for the next 50 years. On main highways, trees should not be planted nearer the road, in most cases, than 25 ft. from the center line. On subordinate roads a little less space may be needed, although the 50-ft. spacing should be observed so far as possible.

Frequently the right of way is less than 50 ft. wide and in such cases there may be difficulty with landowners. Where the road is merely a right of way for public travel, the fee resting with the abutting owners, the owners may prevent tree planting. Moreover, if the trees are not planted within the right of way, they can not be fully protected, which is another source of difficulty.

The chief opposition to tree planting comes from farmers, who object to it because the trees shade the fields and extract moisture and soil fertility from the ground in their immediate vicinity. While this is true of certain varieties, there are others, such as the locust, walnut, persimmon and coffee trees, that interfere with crops only to a very small extent, if at all. It is believed that the proper selection of trees would overcome this objection.

Another obstacle is the location of pole lines along the highways. Trees planted along the roads will come into contact with the wires within a few years and from that time on there will be a conflict of interests. Where a road is sufficiently wide it may be possible to place the trees in such a way that they may be trained above the wires. Where this is not possible, the wires may be carried through the branches in cables, as is being done in many small cities. Eventually, the wires may be carried in conduits or on poles erected on private rights of way outside of the roadway.

(Concluded on page 220)

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* Abstract of an article in the September issue of "Public Roads," the official publication of the Bureau of Public Roads, U. S. Department of Agriculture.

† State Forester of Maryland.

The Engineer Student and Public Service[*]

By A. N. JOHNSON[†]

An important field which the engineer has scarcely entered, and in which he now plays but a very small part, indeed, is the direction of public affairs. The rôle that is to belong to the engineer is hardly realized, even by the profession itself, much less by the general public. But there is arising in the minds of engineers of vision a realization of the larger field of usefulness that awaits the technically trained man.

There have been few meetings of engineering societies, held in recent years, at which the question of recognition of the engineering profession by the public has not been discussed. Arguments, supported by statistical data, have been presented that demonstrate the value of the engineer's service to modern civilization, often accompanied by the complaint that the public has not been duly appreciative. In some instances, to be sure, the discussion has revolved about the rather narrow and selfish phase of the situation, that of increased compensation for the technical services of engineers. But usually a broader viewpoint has been held, with the object to secure to members of the profession a greater degree of responsibility in the direction of public affairs.

As typical of the sentiment expressed, the following extracts from a recent address before the student members of the American Society of Mechanical Engineers by Dexter Kimball are of interest.

"If the engineer," he said, "has not been appreciated as much as some other classes of men, it is because his service to humanity has not been the highest"; but, he concluded, "I have every confidence the engineer will rise to this opportunity, and there are many signs that these ideals are stirring in the minds of forward looking engineers."

The profession in England finds itself in much the same position as in America as regards its participation in public affairs. An editorial from the November, 1920, "Engineering" calls attention to the fact that England has never had an engineer as prime minister, nor in fact in any ministerial office, until the exigencies of the war compelled recourse to their services "to make things go." Among a number of instances mentioned, as illustrative of the utter disregard of the public for engineers' services, is one in which evidence was given before a committee on London traffic and the principal witnesses were not at all the engineers in the employ of the committee, but the leaders of a political party, "who gave completely erroneous testimony on highly technical points."

In the opinion of this editorial, the serious obstacle to the engineer playing a more pronounced part in public affairs lies in the little interest taken by the public in the details of his work. But this would appear to be a secondary rather than a primary cause, for the public takes an interest in those things about which it is informed. If the engineer does not inform the public as to his work, and does not display an interest in public affairs, it is not surprising that the public takes but little interest in the engineer's affairs.

Another writer, commenting on the part engineers have taken in public health activities, calls attention to the opportunities for engineers in this service; that they are limited "only by what the profession chooses to impose upon itself. Except those communicable diseases transmitted by direct infection, nearly all work to suppress and eradicate disease involves engineering problems for the sanitary engineer; but in this phase of the contact of the profession with the public, the activity of the profession has not been manifest."

All the many arguments that are to be found in the proceedings of engineering societies show conclusively, at least to the satisfaction of the engineers, that their training and attainments would secure for the public a more efficient management of many of its more important undertakings; and the engineers are probably right. But the fact still remains that the public does not intrust its affairs to engineers, even in those instances where all agree that the technical skill of the engineer must be employed. And so the engineer reports while someone else directs.

Perhaps sufficient comment has been made as to the present relation between the engineer and the public. That the engineer should have greater recognition and be shown a greater degree of confidence by the public is doubtless true. But it is idle for members of the profession to complain that the public does not render due appreciation of the ability and skill of the engineer. It remains for the engineers, collectively and individually, to take a more active part in public affairs in general. In this particular members of the legal and medical professions have far outstripped the engineers. If the highest recognition is to come to the engineers, they should not wait to give evidence of their interest until some technical phase of a public question arises.

If members of the engineering profession should be intrusted with greater responsibility in the management of public affairs and such has not happened, it seems obvious that the engineers themselves have not, as yet, made the right move for the desired end. That tradition is against such recognition, and that the engineer is usually handicapped by lack of intimate knowledge of the relation between political organization and management of public affairs, is to suggest that engineering schools may be not only of assistance, but have an obligation to discharge to assist their students to gain a different viewpoint as to what their careers may be.

(Concluded on page 224)

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[*] Paper presented at the 27th annual convention of the American Society for Municipal Improvements, Baltimore, Md., Oct. 25-28, 1921.

[†] Dean, Engineering College, University of Maryland.

GOOD ROADS
CONSTRUCTION TRANSPORTATION MAINTENANCE

Founded January, 1892

E. L. POWERS
Editor

T. A. HULBERT
Managing Editor

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Copy for advertisements must reach the New York office by noon on Tuesday of the week before date of issue if proofs are to be submitted.

Copy for classified and other advertisements where proofs are not required will be accepted until noon on Monday of the week of issue.

Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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Vol. LXI November 2, 1921 No. 19

ENGINEERS AND PUBLIC AFFAIRS

The engineer is almost always the under dog. He is poorly paid, over-worked and unappreciated. When great public works are put through he does the planning and carries out the work to the glory and profit of somebody else. His advice is sought, paid for—sparingly—and followed, only to add to the fame and fortune of some lawyer or politician who has been in the center of the stage in the spot-light while the engineer has been shifting the scenery.

Why?

Because, according to a paper by Dean Johnson of the University of Maryland, which is printed on other pages of this issue, the engineer has been content to be a "good technician" and has failed to take a more active part in public affairs. In other words, it's his own fault, for he has hidden his light under a bushel.

This subject is an old one. As pointed out in the paper to which reference has been made, "There have been few meetings of engineers, held in recent years, at which the question of recognition of the engineering profession by the public has not been discussed." It has also been given much space in the technical press. But the matter evidently has not been driven home to the engineers as it must be before they can be roused to action that will land them in what Dean Johnson describes as "the larger field of usefulness that awaits the technically trained man."

The first thing that the engineer has got to do to win recognition is to demonstrate that he is a business man. The present is preeminently an age of Business—with a big "B." Not science, not culture, but trade dominates the activities of mankind. National policies are dictated by industry and commerce; "dollar diplomacy" determines international relations. The World War was caused not by racial animosity, not by revolt against oppression, not by zeal for any cause other than that of trade. Nearly all the professions, art, literature, the drama, are thoroughly commercialized. In an age of materialism, only the engineer—the man whose dealings are primarily with material things rather than with men—has failed to see the handwriting on the wall and to discard some of his old-fashioned ideals and a part of the code of so-called ethics that cumber him.

Usually the engineer is practically a laborer—or a straw boss. Under about the best conditions that ordinarily obtain he is in a position between labor and capital—in other words, in the class included in the euphonious term "management." But even then he is usually in a subordinate position under some so-called executive who draws the real money and appropriates the credit when things go right and passes the buck to the engineer when the job is smeared. As expressed in Dean Johnson's paper, the engineer "reports while someone else directs."

Besides proving his business sense, the engineer has got to assert himself if he wants to succeed. "It remains for the engineers, collectively and individually," Dean Johnson says, "to take a more active part in public affairs in general." In other words, if engineers want recognition, they must go after it. If they won't do that they can hardly expect to get it; watchful waiting won't work.

Graduate Courses at Michigan Short graduate courses in highway engineering and highway transport are to be given at the University of Michigan this winter, in accordance with the schedule printed on other pages of this issue. The courses are intended for men actually engaged in highway engineering and highway transportation and are so arranged that they may be taken during leaves of absence of from two weeks to four months. Men able to attend should find the instruction well worth the cost.

Good Roads Did It A motor truck recently crossed the continent in 159½ hours, actual running time. The distance covered was 3,507 mi., making the average speed practically 22 mi. an hour. Maintaining an average speed of 22 mi. an hour over ordinarily good roads with fairly heavy traffic means keeping as close as possible to a speed of 32 mi. an hour. On a transcontinental trip over some roads by no means "ordinarily good," keeping up an average of 22 would necessitate taking advantage of the good roads encountered to make considerably more than 32. While the trip was undoubtedly a noteworthy performance for the machine and the driver, it also demonstrated that American roads, by and large, are far better than some of their critics would have us think.

Tree Planting Along Public Highways

(Concluded from page 217)

If we want trees along the highways, and if our desires are sufficiently strong, we will have them and such obstacles as pole lines will be removed. There should be general recognition of the principle that planting trees along the highways is a part of the improvement. The objections mentioned are by no means insurmountable.

The real obstacle to earlier attention to the condition of the roadsides has been the lack of public appreciation of the aesthetic and practical advantages of shade trees. As a result, we lack the funds necessary for planting trees, but there is great hope that this condition will soon be corrected by an awakening of public interest that will lead to the making of the necessary appropriations. Perhaps no one factor has contributed more to this awakening than has the influence of the men who went to France and saw what had been done there.

To follow the French example, we first need money, but equally necessary is the creation of state agencies to plan and supervise the planting. Without these, uniform state plans will be difficult, if not impossible, of development. Some of the states have provided the money and other have created the machinery for planting, but none has given the necessary attention to both requirements. Maryland has enacted advanced legislation for protecting trees along its roads and has established legislative framework for highway planting, but, unfortnuately, the lack of an appropriation has greatly limited the work that could be done. Illinois, Massachusetts, New Jersey, New York, Pennsylvania* and a number of other states have passed laws providing for tree planting. but the work has been left almost entirely to local authorities, so that no general schemes have been worked out. The experience in these states indicates that no great advance will be made until both the money and the machinery for state-wide planting have been provided.

For part of the money needed we can doubtless look to the many patriotic organizations. No memorial to those who served in the War could be more fitting and more beautiful than trees along our highways. In Maryland it has been proposed to honor in that way not only those who gave their lives, but all residents of the state who served, and if the plan is carried out as proposed, there will be a tree named for each man and woman who served in the Army, the Navy, the Red Cross and other auxiliary organizations.

Many towns have found that tree lined roads give a wonderfully good impression of the taste and public spirit of their citizens and they will undoubtedly be willing to raise a part of the cost of planting along main approaches.

With an almost endless variety of trees from which to select, there is a kind for every place and there is no soil condition in which some tree will not grow and thrive. We have most abundant resources to draw upon and with the rapidly growing public sentiment in favor of the work, roadside tree planting is destined to advance rapidly within the next ten years.

Instrument to Measure Impact on Bridges

An instrument to measure the impact effect of moving vehicles in crossing a bridge has been devised by the Bureau of Public Roads, U. S. Department of Agriculture. Attached to any part of the bridge structure this instrument makes a photographic record of the effect of the moving load. The amount of stretching or shortening of the part as a result of the shocks, is represented by a fine black line on the photograph.

New Jersey County Road Officials Sentenced

Joseph McKissac and Joseph Camp, members of the Board of Freeholders, and Leaming M. Rice, County Engineer, of Cape May County, N. J., have been convicted of malfeasance in office, growing out of their failure to compel certain contractors to live up to the specifications in the construction of roads in Cape May County.

McKissac was fined $1,000 and sentenced to an indeterminate term of one to three years in the state prison. Camp was given a similar fine and ordered to pay the costs of prosecution, while Rice was given one to three years in state prison and fined $1,000. The defendants have been released on bail pending an appeal.

The Wisconsin State Highway Commission has recently announced that the total mileage of concrete roads built this year will be 309 mi. Waukesha County leads with 45 mi.

Winter Road Work would give jobs to many idle men according to C. M. Babcock, State Highway Commissioner of Minnesota, who states that the proposed highway program in his state would employ at least 10,000 men during the winter, exclusive of additional work in material plants and on the railroads.

The Virginia State Highway Department awarded contracts for 324.08 mi. of state highway, costing $5,709,709.47 during the fiscal year ending Sept. 1, according to Commissioner George P. Coleman. Resurfacing work aggregating 59 mi. to cost $347,380.01, has been undertaken. Additional allotments on 7 projects under way of $68,628.58 bring the total cost of state contracts and resurfacing work on 400 mi. of state highway to the sum of $6,071,214.17.

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* Recent information from Pennsylvania is to the effect that this condition is about to be corrected through the cooperation of the State Highway and Forestry Departments, which together have worked out a comprehensive plan of planting.

Federal Road Legislation

The conference report on the pending highway bill has been approved by the House of Representatives and the Senate and at this writing the measure, carrying an appropriation of $75,000,000, seems likely to become a law without further delay.

As it stands, the bill contains most of the general principles embodied in the Townsend Bill. It makes it mandatory upon any state desiring to participate in the distribution of federal funds to lay out a system of roads consisting of not over 7% of the state's road mileage. Of this 7%, three-sevenths must consist of interstate highways connecting with corresponding roads in the adjacent states, and the remaining four-sevenths must be inter-county roads that connect with the interstate routes. It also provides that 60% of the money allotted to a state shall be spent upon the interstate roads—until they are completed—and also that, the state highway department consenting, all of the state's share of federal aid may be spent on such roads.

States accepting federal aid must also match the federal funds with funds of their own and must provide for the maintenance of the roads built with federal aid.

GRADUATE SHORT COURSES IN HIGHWAY ENGINEERING AT MICHIGAN

University of Michigan Offers Selected Courses for Highway Transport Engineers during the Winter Months

Short graduate courses in highway engineering and highway transport will be conducted during the winter months at the University of Michigan, under the direction of Arthur H. Blanchard, Professor of Highway Engineering and Highway Transport. As shown in the subjoined schedule, the courses are to be given in periods of two weeks each, beginning early in December and continuing until the middle of March. The courses are intended for men engaged in highway engineering and highway transport work. A man may take one course only, or any desired combination of courses. Additional information may be secured by addressing Prof. Blanchard at the University of Michigan, Ann Arbor. The schedule of courses is as follows:

Dec. 5 to 16, 1921.—C. E. 72, Earth, sand-clay, gravel and broken stone roads, Prof. Smith; C. E. 81, American and English highway transport methods, Prof. Blanchard.

Dec. 19 to 31, 1921.—C. E. 77, Highway engineering, financing, management and organization, Prof. Smith; C. E. 79, Highway transport legislation and traffic regulations, Prof. Blanchard.

Jan. 2 to 13, 1922.—C. E. 78, Grading machinery and operations, Prof. Bateman; C. E. 80, Inter-relationship of highway, railway and waterway transport, Prof. Riggs.

Jan. 16 to 27, 1922.—C. E. 68, Bituminous surfaces and bituminous pavements, Prof. Blanchard; C. E. 82, Highway transport costs and record systems. Prof. Smith.

Jan. 30 to Feb. 10, 1922.—M. E. 40, Mechanism, operation and maintenance of motor trucks, tractors and trailers, Prof. Lay; C. E. 79, Highway laboratory research, Prof. Bateman; C. E. 70, Highway structures, Prof. Gram; C. E. 84, Highway transport management, Prof. Smith.

Feb. 20 to Mar. 3, 1922.—C. E. 67, Highway transport economics and surveys, Prof. Blanchard; C. E. 73, Brick, cement concrete, stone block and wood block pavements, Prof. Bateman.

Mar. 6 to 17, 1922.—C. E. 71, Highway specifications, contracts and jurisprudence, Prof. Riggs; C. E. 75, Highway engineering seminar, Prof. Blanchard; C. E. 76, Highway engineering theory and design, Prof. Smith; C. E. 83, Highway transport seminar, Prof. Blanchard.

Truck Crosses Continent in Less Than Two Weeks

Demonstrating its value in long distance highway transportation, a 5½-ton truck arrived in New York recently, after making a transcontinental run from Los Angeles in 6 days, 15 hours, 23 minutes, actual running time. The distance covered was 3,507 mi., averaging practically 22 mi. per hour while the truck was on the road. The total elapsed time was 12 days and 14 hours.

The truck differs from the ordinary truck in that it has six wheels all equipped with pneumatic tires and was manufactured by the Goodyear Tire & Rubber Co. for its long distance express routes. Half a dozen of these trucks were built by the Goodyear Company but this is the first time that a transcontinental run has been attempted by a motor truck of that type. An element of additional safety is provided in the equipment of brakes on the four wheels, two of which are placed on the rear of either side of the machine.

The six-wheel trucks have been built with a view of obtaining the maximum speed consistent with the load and with a minimum wear and tear upon the roads.

Material from the Goodyear factory in Los Angeles was carried by the truck to the New York branch. Upon arrival at New York the truck had actually made a round trip transcontinental journey, as it left New York for the coast several weeks ago. The return trip was over the Santa Fe Trail to Kansas City and from there the greater part of the trip was made on the Lincoln Highway. The fastest single day's run was 420 mi., accomplished in 17 hours, through New Mexico and Arizona. From Philadelphia to Jersey City, a distance of 93 mi., the run was made in three hours. The total weight including the load was 21,800 lb.

Motor Trucks Transport 35% of the livestock sold at Indianapolis, Ind. A separate division of the yard is provided for unloading animals hauled to it.

Over $12,000,000 Worth of Roads are under construction or are contracted for in Missouri, according to E. J. McCaustland, Dean of the School of Engineering of the University of Missouri.

Bureau of Public Roads to Study Truck Operating Costs

Costs to the Government to operate motor vehicles engaged in road building will shortly be determined through a system of cooperative records installed by the Bureau of Public Roads, U. S. Department of Agriculture.

The Bureau has retained a large number of motor vehicles out of the surplus war material turned over by the War Department after the world war and these are now being used principally on forest road work in the West. These motor vehicles are kept at various central points where shops are maintained for repair work.

Complete records will be kept of all oil, gasoline and supplies of every kind used by each vehicle. Even the number of tube patches will be kept and record will also be kept of the number of hours of shop work required; of days idle, and why; of distances loads are carried and the character of the loads; and the gross income from the operation of the vehicles. The information thus obtained will be combined with similar information from some of the states operating the surplus war equipment turned over to them, and will form a valuable addition to the knowledge of the cost of highway transport.

New York Scenic Highway Opened

Two hundred persons participated in the recent opening of the first 5-mi. section of the Henry Hudson Drive in the New Jersey-New York Interstate Park, between Englewood, N. J., and the top of the cliffs at the village of Alpine, N. J.

Following short ceremonies at the Englewood entrance to the drive, Mrs. George W. Perkins cut the red, white and blue silk ribbon that barred the roadway, and a dozen automobile buses containing the guests of the Park Commissioners passed into the park to inspect the drive. Returning later, luncheon was served at Englewood.

When completed, the Henry Hudson Drive will constitute the southern end of an interstate highway along the west bank of the Hudson, from Fort Lee to Albany. In 1909, New Jersey authorized the construction and maintenance of the drive as her share of the celebration of the tercentenary of the discovery of the Hudson.

From Englewood to the boulevard at Alpine is a little more than 5 mi. and the spur to the Alpine dock is ½ mi. long. The surface of the driveway is 16 ft. wide, 24 ft. including the gutters, and is constructed of telford macadam, bituminous bound, and commands many fine views of the Hudson. The drive was built over ground which is extremely uneven, requiring a large number of cuts and fills, its grade being over 6% in only a few places. The total cost of that portion of the drive just opened was $443,107.09, all of which has been paid from appropriations made by the State of New Jersey.

Speakers at the opening ceremonies were: Richard Lindabury, President of the New Jersey Palisades Park Commission; F. W. Hopkins, Acting President of the New York Palisades Park Commission; Herbert L. Sisson, State Commissioner of Highways of New York; Edmund W. Wakelee; Cleveland H. Dodge; Dr. George Kunz, President of the American Scenic and Historic Preservation Society; Mrs. J. A. Holland, Montclair, N. J.; Mrs. A. B. Proal, President of the New Jersey State Federation of Women's Clubs; W. Irving Glover, Third Assistant Postmaser-General.

"Safety First" Efforts in Schools

That the school room is an appropriate place to spread the gospel of "safety first," is the belief of the Highway and Highway Transport Education Committee which recently opened a contest for the purpose of inducing school children to write essays on the subject and to encourage grammar school teachers to promote such efforts among their pupils.

The American Automobile Association which is actively participating in the contest is asking the cooperation of its 700 affiliated clubs in featuring the last week of the contest, December 4 to 10, in furtherance of special observance of the rules of "safety first" in every section of the country.

In addition to other prizes the teacher producing the best class room lesson for the grammar school grades, the first prize will be $500 and a trip to Washington with all expenses paid. The second and third prizes, respectively, will be $300 and $200.

Organizations cooperating in the contest are: the National Education Association, the Mothers' Congress of Parent-Teachers Association, General Federation of Women's Clubs, National Grange, National Automobile Dealers' Association, Motor and Accessory Manufacturers' Association, National Safety Council, Playground and Recreation Association of America and the American Automobile Association.

◆

Two Grade Crossings in Bucks County, Pennsylvania, have been ordered abolished by the State Public Service Commission. These crossings are on the Philadelphia and Easton Electric Railways Co.

North Carolina has Obtained a Loan of $5,000,000 at 5.59% from bankers in New York, according to a recent dispatch, for the purpose of road construction. It is stated that this is the first time within a year that the state has been able to borrow money at less than 6%.

The Maintenance of 293 mi. of Improved Roads in Berks County, Pennsylvania, required the use of 330,000 gal. of oil and over 50,000 tons of stone. Fifteen miles of water-bound macadam roadbed were rebuilt during the year and five concrete bridges were erected on the various roads. Over 600 men were employed under Superintendent of State Highways Wayne M. High to accomplish the work.

MEETINGS

Calendar of Coming Meetings

Nov. 14-16—City Managers' Association.—Annual convention, Chicago, Ill. Secretary, H. G. Otis, City Manager, Clarksburg, W. Va.

Nov. 16-18—National Municipal League—Annual convention, Chicago, Ill. Secretary, H. W. Dood, 261 Broadway, New York, N. Y.

Jan. 17-20, 1922—American Road Builders' Association.—Nineteenth Annual Convention, Twelfth American Good Roads Congress and Thirteenth Good Roads Show under the auspices of the A. R. B. A., The Coliseum, Chicago, Ill. Secretary, E. L. Powers, 11 Waverly Place, New York, N. Y.

American Road Builders' Association

The annual meeting and "get-together" dinner of the American Road Builders' Association will be held at the rooms of the Automobile Club of America, 247 W. 54th St., New York, N. Y., on Tuesday, Nov. 15, at 3:00 p. m.

Besides the election of officers, the meeting will take up a number of amendments to the constitution and bylaws of the organization.

The dinner will be held in the grill room at 6:30, the price being $2.50 per plate.

Northwestern Section, American Society of Civil Engineers

At a recent meeting of the Northwestern section of the American Society of Civil Engineers held in Minneapolis, W. T. Walker, Construction Engineer of the Northern States Power Co., was elected President. Other officers elected were: G. H. Herold, Engineer for the St. Paul City Planning Board, First Vice President; Jas. B. Gilman, Chief Engineer of the Minneapolis Steel & Machinery Co., Second Vice President; Paul C. Gauger, of St. Paul, Secretary and Treasurer.

American Society for Municipal Improvements

The 27th annual convention of the American Society for Municipal Improvements was held at Baltimore, Md., on Oct. 25, 26, 27 and 28, with a total attendance of about 500, of which some 140 were members and associate members.

Maj. R. Keith Compton, Chairman of the Baltimore Paving Commission, in his presidential address, urged that a conference of mayors be made a feature of the annual convention and that the society take steps to stimulate construction activities as a relief for unemployment.

The interest of road builders and highway officials centered upon the reports of the committees on standard paving specifications and upon highway traffic and transportation. As a rule, few changes were recommended. The Sub-Committee on Bituminous Macadam, Bituminous Concrete and Asphalt Block Pavements, of which Linn White, Chief Engineer of the South Park Commissioners of Chicago, is chairman, recommended that in the bituminous concrete specifications the provisions for a grading consisting of one product of the crusher as one alternative and the Warren Bitulithic pavement as the other be discontinued and in their place there be substituted a single specification for a grading approximately that of the Warren specifications. This change is to be sent out in letter ballot form.

The report of the Sub-Committee on Brick Pavements, Geo. F. Fisk, Assistant Engineer in Charge of Pavement Construction, Buffalo, N. Y., chairman, induced some difference of opinion. The report proposed limiting blocks to the lug type, while the manufacturers argued for the adoption of alternate specifications admitting plain brick. It was decided to hold the matter open for another year.

The Committee on Traffic and Transportation, of which Prof. Arthur H. Blanchard is chairman, made a number of specific recommendations, including the use of dummy cops and the installation of rotary traffic at street intersections, the use of long-radius curb corners and the utilization of by-pass highways around towns and cities situated on important trunk highways. The report also condemned "wild cat" jitney service, both as unduly congesting traffic and as unfair competition with public service utilities operating under franchise. The report recommended the inclusion of a highway transport division in the engineering or highway department of any city of over 100,000 population.

Besides these committee reports, there were presented several papers on roads and streets. A program of the convention was printed in "Good Roads" for Oct. 5, 1921.

Cleveland, Ohio, was selected for the convention in 1922 and officers for the coming year were elected as follows:

President, Edward S. Rankin, Engineer in Charge, Bureau of Sewers, Newark, N. J.; First Vice President, W. W. Horner, Principal Assistant Chief Engineer of Sewers and Paving, St. Louis, Mo.; Second Vice President, Ellis R. Dutton, Assistant City Engineer, Minneapolis, Minn.; Third Vice President, H. H. Smith, Deputy Chief Engineer, Board of Estimate and Apportionment, New York, N. Y.; Secretary, Charles Carroll Brown, Engineer, Department of Public Works, St. Petersburg, Fla.; Treasurer, Linn White, Chief Engineer, South Park Commissioners, Chicago, Ill.

PERSONAL MENTION

Prof. L. S. Smith, head of the highway engineering and city planning courses of the University of Wisconsin, has been appointed engineer of the Appleton, Wis., City Plan Commission.

Capt. J. D. Fauntleroy, U. S. District Engineer, in company with Assistant State Highway Engineer Kendall, has recently completed an extended inspection trip through southeast Texas.

Walter J. Hill, son of the late James J. Hill, whose home is in Livingston, Mont., plans to cooperate with local commercial organizations of Park County in asking the Federal Government to build a concrete highway between the Livingston and the Gardiner entrances to Yellowstone National Park.

Prof. H. S. Jacoby, of Cornell University, a well known authority on bridge engineering, will retire from active duty at the end of the present college year. Prof. Jacoby has been on the faculty of Cornell for the past 31 years and has been head of the department of bridge engineering for the past 21.

OBITUARY

William E. LeBarron, for 12 years with the Berger Manufacturing Co., of Minneapolis, died recently at the age of 62 years. He was in charge of the corrugated culvert department of the company.

Robert E. Kirk, Deputy County Surveyor of Hennepin County, Minneapolis, died recently at the age of 74. He was a civil engineer and a graduate of Edinborough College and came to Minneapolis in 1866, where he was in charge of the construction of the first 65 mi. of the Soo Line track out of the city. He afterward made his home at Aberdeen, S. D., until 1897, when he returned to Minneapolis. Mr. Kirk was active in road development for many years and served as deputy county surveyor for 11 years.

The Engineer Student and Public Service

(Concluded from page 218)

When the only outlook presented the student is to become a good technician, there need be little surprise felt if these men individually, or as a group, develop a field of activity that occupies in the public mind a position secondary to that of men who look forward to careers in public life and take and are conceded leadership in public activities.

It was with these considerations in mind that the following statement was written as it appears in the 1921-22 catalogue of the University of Maryland. Under the heading, ''Engineering College,'' it states that the courses are undergoing reorganization and that:

''The general purpose is to broaden the courses of instruction the better to prepare young men to enter the public service. The large public works program contemplated in practically every state in the union makes urgent the demand for engineers trained for such work. The public service demands the electrical and mechanical, as well as the civil engineer. Maryland needs such men to carry on her great highway and large public undertakings contemplated in various cities and counties. Such training seems preeminently a function of the state's university.

"It is not the intention that the subject matter of the courses shall be essentially different from that usually given, but that the viewpoint of the student and the application of the principles will be that of public service. In order to give the time necessary both to the technical subjects and to those of a more general character, a careful revision of all courses of study is being made so that the utmost time available in each term may be used to the best advantage."

Why not inculcate in the mind of the young engineer that he is as well fitted ''to rise in meeting'' and discuss the public question of his community, as, say, his brother from the law school? Why not give him the inspiration to take part in public affairs? Why not dispel whatever remains of the tradition that the technically trained man should shun politics? All of these things can be done by our engineering schools. Should they do them?

It is the writer's conviction that it must be done if the engineer of tomorrow is to discharge in a larger and fuller measure his obligation, not alone to himself and his profession, but to his community. We shall not, much longer, be able to carry on our public and quasi public affairs as in the past. The call is to come to the trained man, to the engineer to take charge. In the new fields that await him, he will have far greater responsibilities. Let us help him be prepared.

The Books of the State of Minnesota were balanced recently and it was found that the last quarter of the year started with a balance of $15,100,621.03. It was announced by State-Treasurer Rines that this amount would be considerably diminished during the next few months by payments to schools and for state road construction.

A Roadside Tree Planting Campaign for the beautification of the highways has been started by civic societies in the various towns in the Cumberland Valley, in Pennsylvania, as a memorial to the soldiers of the late war. Cooperating with the civic societies will be the Rotary Clubs and posts of the American Legion. State Highway Commissioner Lewis Sadler and the State Department of Forestry have made arrangements for the survey by foresters of the highways as the first step in the planting work.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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Concrete Roads must be Reinforced

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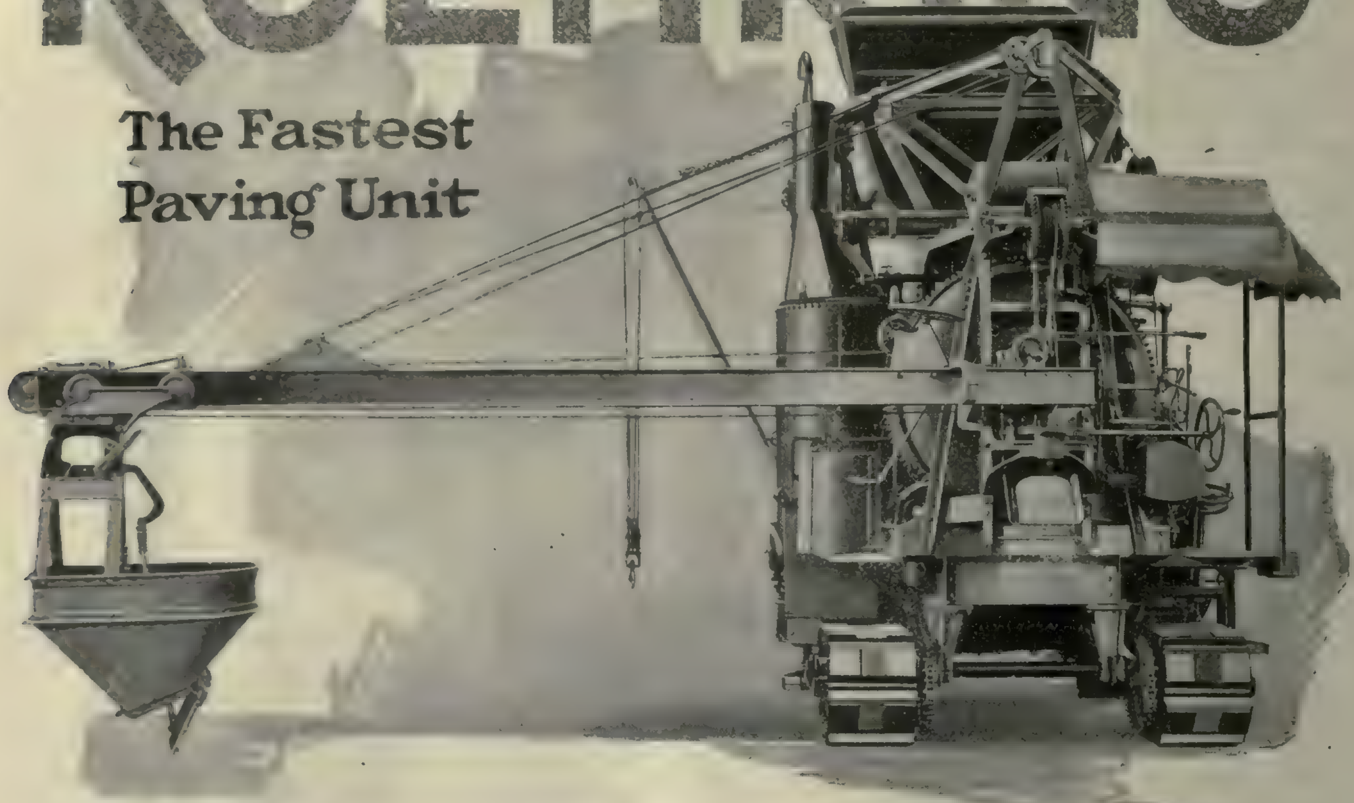

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GOOD ROADS

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THE HIGHWAY CONTRACTOR AND ROAD BUILDER

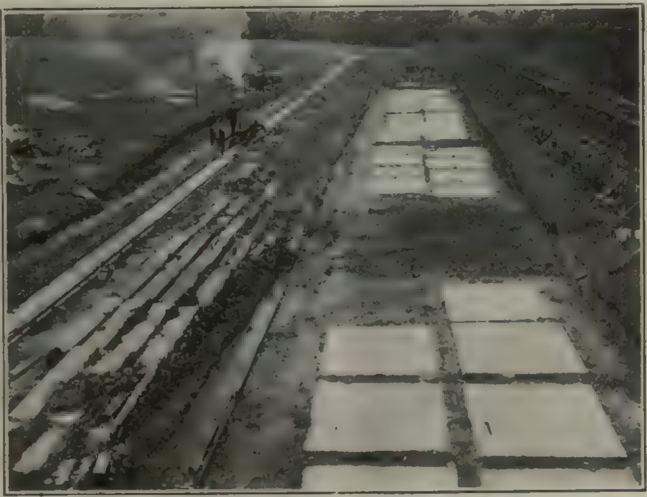
Vol. LXI. NEW YORK, N. Y., NOVEMBER 16, 1921 Number 20.

Tests of Impact on Pavements by the Bureau of Public Roads—I*

Purposes of the Tests—Detailed Description of the Test Slabs—Methods of Construction—Description of the Impact Testing Machine

By C. A. HOGENTOGLER†

For the intelligent selection of a road surface there must be known (1) the character and magnitude of the loads to be supported, (2) the condition of support offered by the subgrade, and (3) the resistance of various kinds of pavements under the required conditions of loading and support. Intelligent selection differs from design in that the latter involves, for roads as well as other engineering structures, investigations of the stresses which are developed in the materials comprising the structure and a determination of the resistance of these materials to given stresses. While the ultimate aim of all highway research is to secure such data as will permit the rational design of road surfaces, it must be realized that considerable time will elapse before the information derived from investigations of this kind can be made available for use and that highway construction can not be postponed until such information is available. The U. S. Bureau of Public Roads, realizing the extreme need of immediate information, inaugurated three projects the purpose of which was to make available immediately information which would help the highway engineer to make a rational selection of pavements.


GENERAL VIEW OF SLABS—WATERED DITCHES IN FOREGROUND; DRY IN BACKGROUND

From the first project, involving a study of impact forces produced by motor trucks,[1] it was hoped to determine to some extent the magnitude and character of the forces delivered to a road by motor truck wheels. The second project, that of impact tests on road slabs, was designed to throw light on the behavior and resistance of various types of pavements when subjected to forces similar to those produced by heavy motor trucks. The third project, an investigation of subgrades, was undertaken for the purpose of determining the conditions of support that can be expected to be offered to the road surface by the subgrade. The present paper concerns only project No. 2, the impact tests on slabs, and gives the results obtained from observations made for the purpose of determining the resistance of the various types of pavements to impact forces similar to those produced by the wheels of heavily loaded motor trucks, and while its purpose is principally to help in the selection, there is also included information which might assist in the design of pavements.

Description of Test Slabs

For the experiment there were constructed at the Arlington (Va.) Experimental Farm 56 7x7-ft. sections of standard types of pavements. This series of slabs, as detailed in Table 1-A and 1-B, was comprised of concrete, monolithic, semi-monolithic, bituminous, and grout-filled brick with sand and screening cushions on concrete and macadam bases.

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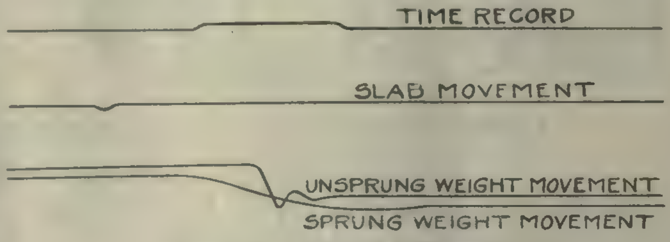
* From "Public Roads," the official publication of the Bureau of Public Roads, U. S. Department of Agriculture, October, 1921.

† Highway Engineer, Bureau of Public Roads, U. S. Department of Agriculture.

[1] "The Motor Truck Impact Tests of the Bureau of Public Roads," E. B. Smith, "Public Roads," Vol. 3, No. 35, March, 1921.

The slabs were constructed in two sections with ditches surrounding each section. In order to determine the effect of moisture in the subgrade the ditch around one section was kept filled with water at all times, for the purpose of effecting an extremely wet condition of the subgrade; while the ditch around the remaining slabs was used to keep the subgrade as dry as possible. As the majority of the slabs in the dry section were duplicated in the wet section this arrangement permitted a direct comparison under the two conditions. To insure a natural condition of the subgrade the top layer of soil was removed, after which the earth was carefully graded by cutting to the desired elevation. There were no fills and there was no compacting by tamping.



A TYPICAL AUTOGRAPH RECORD

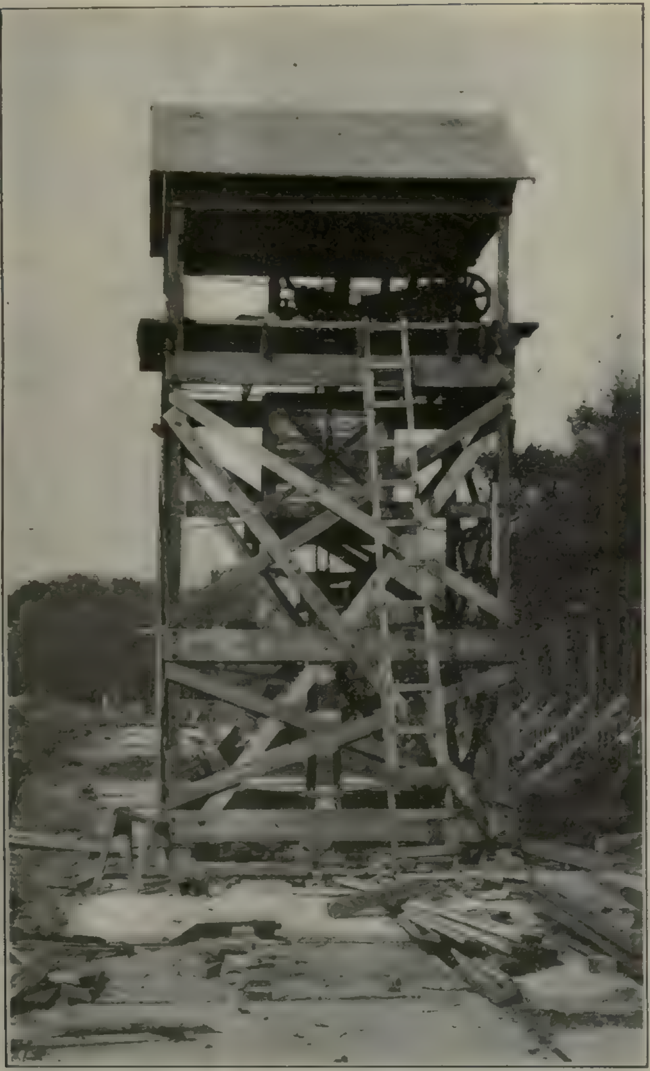
TABLE 1-A—DETAILS OF TEST SECTIONS LAID ON WET SUBGRADE.

Slab No.	Base.			Cushion.		Surface.			Joint filler.	
	Thickness.	Material.	Date laid.	Thickness.	Material.	Thickness.	Material.	Date laid.	Material.	Date poured.
	Inches.		1919.	*Inches.*		*Inches.*		1919.		1919.
1	12	Macadam	July 3	1	Screenings	4	Wire cut lug brick	July 3	Cement grout 1:1	July 3
2	4	1:3 6 concrete	May 20	½	Tar-sand	4	do	do	Tar sand 1:1	July 9
3	6	Macadam	June 25	1	Screenings	4	do	June 25	Cement grout 1:1	June 25
4	4	1:3:6 concrete	May 20	1	Sand-cement 4:1	3½	Vert. fiber brick	June 16	Asphalt	June 17
5	6	do	do	1	Sand	3½	do	June 14	do	Do.
6	4	do	do	1	do	3½	do	do	do	Do.
7	6	do	do	1	Sand-cement 4:1	4	Wire cut lug brick	June 12	Cement grout 1:1	June 12
8	4	do	do	1	do	4	do	do	do	Do.
9	6	do	do	1	Sand	4	do	June 11	do	June 11
10	6	do	do	1	Sand-cement 4:1	3½	Vert. fiber brick	June 16	Asphalt	June 17
11	6	do	do	1	Sand	4	Wire cut lug brick	June 10	Cement grout 1:1	June 10
12	4	do	do	1	do	4	do	do	do	Do.
13						10	1:1½:3 concrete	Mar. 29		
14						8	do	do		
15						6	do	do		
16						6	do	do		
17						4	do	do		
18						2	do	do		
19	6	1:3:6 Concrete	June 19							
20	3	do	June 22	½	Sand-cement 3:1	3	Wire cut lug brick	June 22	Cement grout 1:1	June 22
21	4	do	do	½	do	3	do	do	do	Do.
22	2	do	June 23	½	do	4	do	June 23	do	June 23
23	6	do	do	½	do	4	do	June 22	do	June 22
24	1	do	do	½	do	4	do	June 23	do	June 23
25	4	do	do	½	do	4	do	do	do	Do.

TABLE 1-B—DETAILS OF TEST SECTION LAND ON DRY SUBGRADE.

Slab No.	Base.			Cushion.		Surface.			Joint filler.	
	Thickness.	Material.	Date laid.	Thickness.	Material.	Thickness.	Material.	Date laid.	Material.	Date poured.
	Inches.		1919.	*Inches.*		*Inches.*		1919.		1919.
101	6	1 3.6 concrete	May 23	1	Sand	3½	Vert. fiber brick	June 13	Asphalt	June 17
102	4	do	do	1	Screenings	4	Wire cut lug brick	June 17	Cement grout	Do.
103	6	do	do	1	Sand-cement 4:1	3½	Vert. fiber brick	June 13	Asphalt	June 16
104	4	do	do	1	Screenings	3½	do	June 16	do	June 17
105	6	do	do	1	Sand-cement 4:1	4	Wire-cut lug brick	June 13	Cement grout 1:1	June 13
106	4	do	do	1	do	4	do	June 12	do	June 12
107	6	do	do	1	Sand	4	do	June 11	do	June 11
108	4	do	do	1	do	4	do	do	do	Do.
109						10	1:1½:3 concrete	Mar. 25		
110						8	do	do		
111						6	do	do		
112						6	do	Mar. 29		
113						4	do	Mar. 25		
114	6	1:3:6 concrete	June 17	1	Screenings	4	Wire-cut lug brick	June 18	Cement grout 1:1	June 18
115						2	1:1½:3 concrete	Mar. 29		
116	6	1 3 6 concrete	June 17	½	Tar-sand	4	Wire-cut lug brick	July 8, 12	Tar-sand 1:1	July 9, 12
117	6	do	May 24	1	Screenings	3½	Vert. fiber brick	June 16	Asphalt	June 16
118	4	do	June 17	½	Sand-cement, 3:1	3	Wire-cut lug brick	June 17	Cement grout, 1:1	June 17
119	3	do	do	½	do	3	do	do	do	Do.
120	6	do	June 18	½	do	4	Repressed brick	June 18	do	June 18
121	4	do	do	½	do	4	do	do	do	Do.
122	6	do	June 19	½	do	3½	Vert. fiber brick	June 19	do	June 19
123	4	do	do	½	do	3½	do	do	do	Do.
124	6	do	do							
125				1	Screenings	4	Wire-cut lug brick	do	Cement grout 1:1	Do.
126	6	1 3 6 concrete	June 20	½	Sand-cement, 3:1	4	do	June 20	do	June 20
127	1	do	do	½	do	4	do	do	do	Do.
128	4	do	do	½	do	4	do	do	do	Do.
129	2	do	do	½	do	4	do	do	do	Do.
130	12	Macadam	July 3	1	Screenings	4	do		do	
131	6	do	June 25	1	do	4	do		do	

On the sub-bases thus prepared the concrete, which



IMPACT MACHINE OF BUREAU OF PUBLIC ROADS IN POSITION OVER A SLAB

was machine mixed, was poured, thoroughly tamped, and finished with a wooden float. After final set the slabs were cured by covering for two weeks with a layer of wet earth. For the concrete surfaces a $1:1\frac{1}{2}:3$ mix was used, while for the bases the mix was $1:3:6$.

Tables 2 to 6, inclusive, show the results of tests of the sand and gravel used for aggregate and of the sand, tar, and asphalt used for fillers. In the monolithic sections a $\frac{3}{16}$-in. sand-cement dry 1:1 mortar was placed on the green base and leveled for receiving the brick. After the brick were laid, tamped, and sprinkled, the cement grout filler which was mixed by hand in a box was applied to the surface with buckets and spread by means of a broom and squeegee until all joints were filled, when the excess filler was pushed off the sides of the slabs. In the monolithic slabs the construction was begun and completed the same day. The semi-monolithic construction differed from the above only in the detail that a 1-in. instead of a $\frac{3}{16}$-in. layer of dry mortar was used and this mortar was not laid on the base while it was green. On the bituminous filled sections, the hot filler was poured into the joints by means of a pouring pot with a spout, as soon as the bricks were laid and rolled on the different cushions.

The mastic filler was made of tar mixed with hot sand, in proportions of 1:1 by volume, and for the mastic cushion the tar was mixed with hot sand in the proportion of 1 gal. to 1 cu. ft. The analyses of the tar and asphalt used as fillers and in the mastic are shown in Tables 5 and 6. The macadam bases were constructed by means of a hand roller and heavy tampers. After the maximum compaction was secured the 1-in. screening cushions were spread and leveled and the brick tops were laid in a manner similar to those on the concrete bases.

During the construction, test beams similar in material and thickness to the slabs and 13 in. wide by 7 ft. long were made, and 6x12-in. compression test cylinders were made to represent the concretes used for bases and surfaces. It was expected that the tests on the beams would supply information in regard to the elasticity and moduli of rupture of the different types when subjected to static loads, and also afford a means of comparing the effects produced by static and impact forces. Tests of the cylinders will make possible a comparison between compressive strength and resistance to impact. The beams and cylinders were cured in the same manner as the slabs, and it was intended that both should be tested at the same time.

UNSPRUNG WEIGHT OR PLUNGER AND AUTOGRAPHIC RECORDING DEVICE

Description of the Impact Machine

A special machine was designed and built for the purpose of delivering impact blows to the road slabs. The paramount idea controlling the design of this apparatus was that it should deliver a blow, the effect of which would be exactly the same as that caused by the dropping of a wheel of a heavy motor truck. To satisfy this condition it was deemed essential that the spring, the weights above and below it, and the tire or

TABLE 2.—*Test of sand used as concrete aggregate.*

Source of material: Potomac River, Washington, D. C.

Mechanical analysis:	Per cent.
Retained on ¼-in. screen	....
Passing ¼ in., retained on 10-mesh	15.2
Passing 10-mesh, retained on 20-mesh	12.4
Passing 20-mesh, retained on 30-mesh	14.0
Passing 30-mesh, retained on 40-mesh	19.2
Passing 40-mesh, retained on 50-mesh	11.6
Passing 50-mesh, retained on 80-mesh	17.6
Passing 80-mesh, retained on 100-mesh	1.6
Passing 100-mesh, retained on 200-mesh	4.4
Passing 200-mesh	4.0
Total	100.0
Loss by washing (silt and clay)	2.4

Tensile strength (cement-sand briquets, 1:3):

Standard Ottawa sand.		Sample sand.	
7 days.	28 days.	7 days.	28 days.
250	280	285	365
240	320	285	335
245	270	285	350
[1] 245	[1] 290	[1] 285	[1] 350

[1] Average.

Strength ratio (7 days) 116.3%.
Strength ratio (28 days) 120.6%.
Character of material: Sample consists essentially of angular quartz sand containing some chert and very little clay.

TABLE 3.—*Test of sand for grout*

Source of material: Washington, D. C.

Mechanical analysis.	Per cent.
Retained on ¼-in. screen	0.0
Passing ¼ in., retained on 10-mesh	1.0
Passing 10-mesh, retained on 20-mesh	12.6
Passing 20-mesh, retained on 30-mesh	18.6
Passing 30-mesh, retained on 40-mesh	25.8
Passing 40-mesh, retained on 50-mesh	18.6
Passing 50-mesh, retained on 80-mesh	16.2
Passing 80-mesh, retained on 100-mesh	1.4
Passing 100-mesh, retained on 200-mesh	4.6
Passing 200-mesh	6.2
Total	100.0
Loss by washing (silt and clay)	4.0

Tensile strength (cement-sand briquets, 1:3), 7 days:

Standard Ottawa sand.	Sample sand.
285	230
265	235
285	245
[1] 278	[1] 237

[1] Average.

Strength ratio, 85.3%.
Character of material: Sample consists essentially of angular quartz sand stained by iron oxide

TABLE 4.—*Test of gravel for concrete aggregates.*

Source of material: Washington, D. C.

Mechanical analysis:

Sand	Per cent.
Retained on ¼-in. screen	86.5
Passing ¼-in. retained on 10 mesh	11.9
Passing 10-mesh, retained on 20-mesh	.2
Passing 20-mesh, retained on 30-mesh	.1
Passing 30-mesh, retained on 40-mesh	.1
Passing 40-mesh, retained on 50-mesh	....
Passing 50-mesh, retained on 80-mesh	.2
Passing 80-mesh, retained on 100-mesh	.1
Passing 100-mesh, retained on 200-mesh	.1
Passing 200-mesh	.8
Total	100.0
Gravel:	
Retained on 3-in. screen	....
Passing 3 -in., retained on 2½-in. screen	....
Passing 2½-in., retained on 2 -in. screen	....
Passing 2 -in., retained on 1½-in. screen	....
Passing 1½-in., retained on 1 -in. screen	2.9
Passing 1 -in., retained on ¾-in. screen	6.8
Passing ¾-in., retained on ½-in. screen	29.6
Passing ½-in., retained on ¼-in. screen	47.2
Passing ¼-in. screen	13.5
Total	100.0

Loss by washing (silt and clay), 0.75%.
Character of material: Sample consists essentially of subangular fragments of quartz with some chert and sandstone.

TABLE 5.—*Analysis of refined coal tar filler.*

General characteristics: Semisolid.

Water (per cent)	1.5
Specific gravity, 25° C./25° C.	1.2889
Float test, 50° C. (seconds)	260
Total bitumen soluble in carbon disulphide (per cent)	81.5
Free carbon, organic matter insoluble (per cent)	18.2
Inorganic matter insoluble (per cent)	0.3

Distillation:

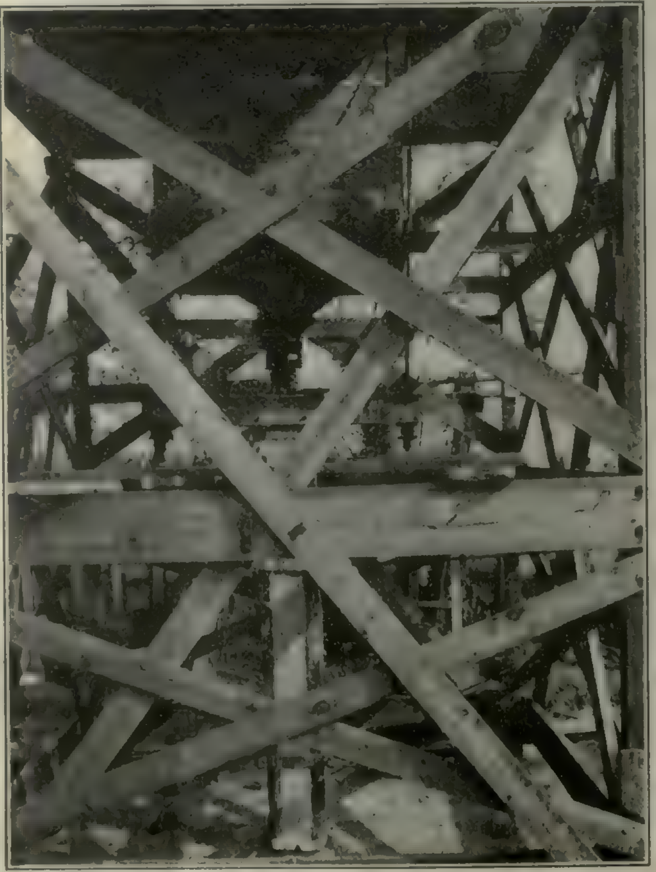
Fractions.	Character.	Per cent by volume.	Per cent by weight.
170° C.	Liquid	2.0	1.02
170° C. to 235° C.	do	1.5	0.97
235° C. to 270° C.	do	4.0	2.62
270° C. to 300° C.	4/5 solid	4.0	2.65
Residue	Soft pitch	88.5	92.58
		100.0	99.84

TABLE 6.—*Analysis of oil-asphalt filler.*

General characteristics: Semisolid.

Specific gravity, 25° C./25° C.	1.026
Flash point (° C.)	245
Penetration, 0° C. 200 grams, 60 seconds	22
Penetration, 25° C. 100 grams, 5 seconds	85
Melting point (° C.)	69
Loss, 163° C., 5 hours (per cent)	0.042
Characteristics of residue: Smooth.	
Consistency of residue—Penetration, 25° C., 100 grams, 5 seconds	25
Total bitumen (soluble in carbon disulphide) (per cent)	99.8
Organic matter insoluble (per cent)	0.2
Inorganic matter insoluble (per cent)	0.0

(Continued on page 231)



ARRANGEMENT OF SPRUNG AND UNSPRUNG WEIGHTS WITH TRUCK SPRINGS BETWEEN

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

Founded January, 1892

E. L. POWERS
Editor

T. A. HULBERT
Managing Editor

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Copy for classified and other advertisements where proofs are not required will be accepted until noon on Monday of the week of issue.

Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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Vol. LXI November 16, 1921 No. 20

THE HIGHWAY ENGINEERING FIELD AND ITS OPPORTUNITIES

One of the most encouraging things about the work of the highway engineer is the manner in which his field of work has broadened in the past decade. It has not yet attained the breadth that it should—or that it will—but a good start has been made and much greater progress in the future can be expected.

Not long ago the engineer engaging in highway work could look forward to becoming little more than a technician. His work consisted of running lines, establishing grades, preparing plans and specifications and making estimates—always under the direction of an executive who, before he secured political preferment, had been a lawyer, a business man, or just a politician. The officials and the principal executive officers were non-technical men and the engineers were little more than skilled workmen. The laymen holding engineering positions by virtue of their political ability naturally got the best salaries and the most congenial work, while the engineers, despite their superior skill, had to be content with wages lower than those of skilled laborers and with positions that were actually, if not nominally, lower than those of some of the workmen and straw bosses in the contactors' organizations. In the old days it was not uncommon to find a trained, experienced engineer working for considerably less than a stone mason or a cement worker on the same construction job. There are still such cases, though they are less common than they were.

With the growth of road building in importance and in public estimation, conditions began to change. Engineers were more often selected for executive and administrative positions and occasionally matters outside of engineering technic were entrusted to them. Questions of finance, administration, organization and legislation came to be recognized as within the province of the engineer as the public and the lawmakers began to realize that engineering meant more than surveying and drafting.

The technical press has played no mean part in bringing about an improvement in conditions and the various engineering publications are still striving—and expect to continue to strive—for the welfare and advancement of engineers working in the fields they serve. But most of the credit for what has been accomplished belongs to the engineers themselves. They have awakened to their opportunities and their responsibilities and have asserted themselves.

While what has been done is good cause for gratification, it is no excuse for complacency. The engineer still has a long road to travel before he reaches the place he ought to occupy and that he can occupy if he will. Highway engineering is a much more attractive and remunerative career than it was ten years ago, but it does not yet offer the opportunities and rewards that it should. Highway engineers have got to keep everlastingly at the job they have started, holding what they have gained and reaching out for more. Road building is a great work and it is going to become greater as the years go by. The field should be the engineer's, and it will be if he determines to make it his.

The Road Show at Chicago Applications for space at the coming A. R. B. A. Road Show call for more space than is available in the Coliseum and steps have been taken to secure additional room. Those in position to know seem to expect no diminution of activity in the road building field.

Our Roads and Those Abroad While America is entertaining so many foreign dignitaries it would be well to take some of them for a trip over one or more of our magnificent rural roads. One of the distinguished visitors might say something that would help uproot the popular fallacy that America is behind the rest of the civilized world in road building.

State Routes in Cities Counsel for a street railway in a certain city argued recently that the state and not the city controlled the city streets. If that principle could be applied universally, states might be more successful in providing uniformly good through highways. Often the part of such a road that is situated within the limits of a city is the worst part.

Plan Michigan Pikes Tour for 1922

The Michigan Pikes Association, in order to create interest in better highways and to popularize through touring routes, has decided to carry out its annual scheme of circuiting one of the Great Lakes next year. The 1922 tour will be around Lake Michigan, while the present year the tour was made around Lake Superior. In 1920 the circuit was made around Lake Huron. The event, next year, as in previous years, will start and finish at Detroit. The date has been arranged tentatively for July 9 and it is planned to make it a 15-day campaign. W. D. Edenburn will be in charge of the tour.

NEW YORK HIGHWAY COMMISSIONER OPPOSED TO NARROW ROADS

State Highway Commissioner Sisson of New York Urges Pennsylvanians to Build 18-Foot Roads

State Highway Commissioner Sisson of New York has advised the people of Pennsylvania against the construction of roads less than 18 ft. in width, according to recent advices from the State Highway Department of the latter state.

"Some weeks ago," said Commissioner Sisson, "I came into Pennsylvania on a mission of discovery. I was agreeably surprised at the progress being made by this state. Shortly after I arrived home I received clippings from several newspapers in Pennsylvania showing that agitation had been started for the construction of narrow roads, on the presumption that they would be cheaper to construct and, therefore, could be put down for a greater mileage. In other words, it was erroneously suggested that Pennsylvania could get twice as many miles of 9-ft. roads as of 18-ft. roads.

"New York State is not building 9-ft. roads on new state highway construction. They are not sufficient to carry modern traffic. In some instances we have built a single strip of concrete 8 or 9 ft. wide on one side of the road, with the intention of building a strip of the same width on the opposite side the following season. But in this case the entire roadway must be graded and culverts and the drainage system for a wide road installed. Therefore, the major portion of the cost of a wide road is expended at the time of the construction of a narrow road. The construction of half a road surface is an expensive proposition, as Pennsylvania would soon find out. The New York State Highway Department does not expect to design roads less than 16 ft. in width in the future, except on thoroughfares of the least importance—and the trouble in this case is that heavy traffic follows improved highways, so that within a short time a minor hard-surfaced road becomes an important artery.

"I am proud of the Pennsylvania highway system as worked out by Commissioner Sadler. It is a marvel.

"Build your roads 18 ft. wide and build the most important ones first. Counties in New York are building roads to connect with the main highways and they are doing a real job of it. The value of a small road is only in the value that it gets out of the main road."

Motor Vehicle Revenues in England

The gross revenue from duties on motor and other vehicles in England for five months ending May 31 of this year was approximately £8,740,000. Of this amount £8,040,000 was from annual licenses and £700,000 from quarterly licenses. The actual amount paid to the highway authorities from the road fund for the same period was £2,863,243. It is estimated that £11,000,000 will be paid out in the year 1921.

Illinois Society of Engineers Offers Prizes for Papers

Five prizes of $25 each have been offered by the Illinois Society of Engineers for technical papers to be presented at the annual meeting at Decatur, Ill., Jan. 24-26, 1922.

A prize will be awarded for the best paper on each of the following subjects: (1) Drainage; (2) Roads and Pavements; (3) Sewerage; (4) Surveying; (5) Miscellaneous Civil and Municipal Engineering. The competition is limited to members of the society of not more than five years' standing and to candidates for election at the annual meeting. The papers must be submitted by Jan. 1, 1922, in accordance with the rules and conditions governing the contest.

Further particulars may be obtained by addressing E. E. R. Tratman, Secretary, Illinois Society of Engineers, Wheaton, Ill.

Contracts for 95 mi. of Illinois Highway were Let on Oct. 14 by the state at a cost of $2,597,769, an average of $27,359 a mi. Col. Miller, Director of Public Works, stated that if the contracts had been let last February the cost would have been $3,800,000, or an average of $40,000 a mile.

The Completion of the Big Lake-St. Cloud Road will be celebrated by an historical pageant showing the settlement and early development of St. Cloud, Minn. The completion of the highway marks the construction of more than 100 mi. of continuous pavement on the Minnesota trunk highway system and a paved road from the Twin Cities to St. Cloud.

Road Improvement in the Argentine is being promoted by the Buenos Aires & Pacific Railway which has begun an active campaign to arouse interest among farmers and land owners in the improvement of roads leading to the railway. Motion pictures have been prepared showing the present state of the roads together with pictures of good roads in the United States and methods of road building. These pictures have been well received in the country districts. The railroad company announces that it will assist in the organization of local committees and the loan of road building machinery and offers the services of its surveyors.

Federal Aid Bill Approved by President Harding

President Harding signed the federal aid bill on Wednesday, November 9. As noted in "Good Roads" for that date, the bill carries an appropriation of $75,000,000 for aid to the states. It also carries an appropriation of $15,000,000 for the construction of roads in the national forests.

New Jersey Counties to Advance Funds for Road Work

Six New Jersey counties have arranged with the state to advance funds for immediate work on roads, the sums expended to be repaid by the state as soon as funds become available. The counties entering into the agreement are Atlantic, Burlington, Cape May, Camden, Ocean and Warren.

"The state system of roads is under the Highway Commission's jurisdiction," Chairman George L. Burton said recently, "but lack of funds at this time may result in a serious hold-up of the whole program unless another plan of finance is adopted. The reimbursement method has been offered as the remedy, and the fact that approximately one-third of the 21 counties already have accepted it augurs well for the completion of the entire system of roads without the obstacle of insufficient funds standing in the way."

Tests of Impact on Pavements by the Bureau of Public Roads

(Continued from page 228)

cushion be identical with those found on trucks. The machine as finally constructed consisted essentially of a loaded box riding on a 5½-ton spring which in turn was supported by a loaded frame or plunger on the bottom of which was a double 2x6-in. solid rubber tire. The box and plunger, representing the sprung and unsprung weights, respectively, could be so loaded as to represent a truck of any size. By means of a motor, gears, and cam, this plunger or unsprung weight carrying the spring and sprung weight could be lifted and dropped from any height so that the effect produced was identical with that of a truck dropping from one level to another, dropping into a hole or falling to the pavement after striking an obstruction. The plunger was lifted and dropped 6 times per minute. One of the accompanying illustrations gives a close view of the apparatus showing, at the top, the box representing the sprung weight supported on the spring which rests on the plunger, while at the bottom can be seen the straps and rods which serve as guides for the plunger. Another illustration gives a view of the apparatus in position for testing over a slab. For the tests described in this article the machine was loaded to represent a 5-ton truck having 1,800 to 6,000 lb., respectively, for unsprung and sprung weights.

A specially designed apparatus, supported independent of the impact machine, autographically recorded space-time curves, showing the movements of sprung and unsprung weights, as well as the vibration of the slabs under impact blows. This apparatus is shown in one of the illustrations. These records, which are the chief source of information on the impact blows, will be described and discussed later. An enlargement of a typical record is shown herewith.

(To be continued)

Important Indiana Highway Formally Opened

Members of the Indiana State Highway Commission, material dealers and many others interested in the good roads movement, recently attended a celebration marking the completion of the last section of the concrete highway between Indianapolis and Greenfield, the county seat of Hancock County.

Former Governor Samuel Ralston and Secretary of State Jackson were the principal speakers. Governor McCray was unable to attend. The celebrants left Indianapolis in automobiles and inspected the highway en route. The road is approximately 20 mi. in length, the first 10 mi. of the highway between Indianapolis and Cumberland having been completed for some time.

The program consisted of a band concert, speaking and a general good time, the citizens of Greenfield turning out en masse to do honor to the occasion.

Good Roads Plans in North Dakota

Preliminary plans for a constitutional amendment at the primaries in 1922 are being made by the North Dakota State Good Roads Association for the purpose of obtaining funds to build approximately 6,000 mi. of hard-surfaced trunk highways running from county seat to county seat and wherever traffic demands permanent roads.

The association urges every county in the state to adopt a trunk road system of highways to connect with the state and federal system. The highways will be built of gravel, scoria and dirt according to governmental specifications and maintained by the state without any tax on property, aside from the levy on passenger automobiles and trucks.

During the past 10 years th ecounties and townships in the state have spent $35,000,000 on patchwork, unsatisfactory pieces of highway, with only about 3,500 mi. of the 70,000 mi. of highway in the state receiving any benefit from this expenditure, the association claims.

A Wall of Solid Granite, 25 ft. deep and about 400 ft. long was thrown about 100 ft. when 5,000 lb. of dynamite exploded in a blast at the Quartzite Quarries 3 mi. from Luverne, Minn. This is said to have been the largest charge of dynamite ever used in a blast in that part of the state. The shot was witnessed by about 2,000 persons from Luverne and vicinity.

MEETINGS

Calendar of Coming Meetings

Nov. 14-16—City Managers' Association.—Annual convention, Chicago, Ill. Secretary, H. G. Otis, City Manager, Clarksburg, W. Va.

Nov. 16-18—National Municipal League—Annual convention, Chicago, Ill. Secretary, H. W. Dood, 261 Broadway, New York, N. Y.

Jan. 17-20, 1922—American Road Builders' Association.—Nineteenth Annual Convention, Twelfth American Good Roads Congress and Thirteenth Good Roads Show under the auspices of the A. R. B. A., The Coliseum, Chicago, Ill. Secretary, E. L. Powers, 11 Waverly Place, New York, N. Y.

American Society for Testing Materials

The 1922 annual meeting of the American Society for Testing Materials will be held at Atlantic City, N. J., during the latter part of June, providing satisfactory arrangements can be made. The decision was made pursuant to the wishes of the members as expressed in replies to a questionnaire sent out by the executive committee.

Preparations are being made for the first annual convention of the Minnesota Federation of Architects and the Minnesota Society of Civil Engineers, which will be held at the Curtis Hotel, Minneapolis, Minn., Feb. 21 to 23.

At a recent meeting at Pikeville, Ky., delegates from Virginia, Kentucky, Ohio and Tennessee, formed an association to promote the construction of a road from Huntington, W. Va., to Knoxville, Tenn. The highway is to be known as the Lonesome Pine Trail. Ben Williams, of Ashland, Ky., was elected president.

CORRESPONDENCE

Why Not Diagonal Joints in Cement Concrete Pavements?

Editor, Good Roads:

As a layman, I am writing to ask you if there is any constructional reason why joints in concrete highways are made straight across instead of diagonally. The difference in traveling over these different types of construction is not alone a matter of physical comfort to the riders, but the wear and tear on the automobile, which is an important consideration. The periodic kick given to the car as both front wheels strike the joint at the same time has a disintegrating tendency.

Theoretically, the joints should not be felt, but even in the best constructed roads they wear unevenly. Where insufficient room is allowed for expansion in the joints they form hummocks and where sufficient room is left they form hollows.

I am not in a position to criticise, except from the point of view of a tourist of some experience, but it seems to me that a road which is considered the finest product of engineering skill should not be more uncomfortable to travel over than a good sand-clay surface.

Is there a constructional reason against diagonal joints?

Jacksonville, Fla. M. Chapman.

PERSONAL MENTION

S. M. Williams has resigned as chairman of the Federal Highway Council.

C. J. Conlin, former road engineer of Cuyahoga County, Ohio, has been appointed construction engineer by the North Carolina State Highway Commission, District No. 4, at Durham.

Philip K. Schuyler, formerly in the bridge department of the Wisconsin Highway Commission, is now with the bridge department of the North Carolina Highway Commission, at Raleigh.

F. H. Joyner has been appointed assistant highways engineer for Los Angeles County, California, by the State Highway Commission, and will have charge of general inspection in the southern district of that state.

F. D. Hudgins, former senior highway engineer with the Bureau of Public Roads, with headquarters at St. Paul, has accepted the position of state highway engineer of South Dakota, with headquarters at Pierre.

Hugh Crozier has been appointed an assistant engineer with the Kentucky State Highway Department at the headquarters office at Frankfort. He was formerly highway engineer for the western district of the state.

R. H. Bennett has been appointed a resident engineer with the Division of Highways, Illinois Department of Public Works and Buildings. He was formerly an assistant engineer on railway construction in Honduras for the United Fruit Co.

The State of Indiana has entered into a contract with the Lincoln Highway Association to provide $33,000 per mile to aid in the construction of the ideal section of the Lincoln Highway to be built in Lake County The ideal section will be lighted electrically for night traffic, in accordance with plans now being prepared by illuminating experts.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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Concrete Roads must be Reinforced

It is demonstrated beyond doubt that to make concrete roads proof against heavy motor traffic, weather and time a fabric of steel must be incorporated in the concrete.

Several great States have so ruled.

American Steel and Wire Company's

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Send for our book on road building

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Patrol gang patching with "Tarvia-K P"

Winter Maintenance Saves Spring Repairs—

It's expensive to neglect your roads through the winter — to abandon them to the freezes and thaws that ravel the surface and play havoc with the foundation. As a matter of fact, proper maintenance is even more important in winter than in summer.

Here's an easy, inexpensive method of maintenance that is being used by experienced road officials all over the country:

Before the snow comes—they patch the road surface with "Tarvia-K P." Then, from time to time during the cold weather, they do whatever further patching becomes necessary. ("Tarvia-K P" can be used whenever the roads are free from snow.) As a result they not only have good roads all winter, but they avoid a lot of expensive repair work in the spring.

"Tarvia-K P" is generally recognized as the most economical, efficient, and convenient-to-use of all road-patching materials. It can be employed on hard roads of every type. It is mixed cold and applied cold. And as the "mix" does not deteriorate with age and is uninjured by freezing, it may be made up in good-sized batches for use as required.

An illustrated booklet giving full directions for repairing different types of roads with "Tarvia-K P" will be sent on request. If you have any troublesome problems in road construction, maintenance or repairs, the Special Service Department will gladly help you solve them. Please address the nearest office.

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GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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THE HIGHWAY CONTRACTOR AND ROAD BUILDER

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Causes of Shoving of Asphalt Pavements*

Cooperative Investigations being Carried on by the U. S. Bureau of Public Roads and Several Cities to Determine the Causes of Shoving under Traffic

By PREVOST HUBBARD†

In common with other types of pavements, many cases of defects in asphalt pavements are due to foundation or subgrade troubles. While the shoving of asphalt pavements is most often attributable to such troubles, it is nevertheless true that in some cases shoving has occurred from other causes. For this reason during the summer of 1921 an investigation of the cause and correction of shoving of asphalt pavements was undertaken by the U. S. Bureau of Public Roads, with the cooperation of the cities of New York (Borough of Manhattan), Philadelphia, Baltimore, Washington and Detroit, and the Asphalt Association. At the time this paper is written, the investigation is in its initial stages and no results have been obtained or conclusions drawn. It has been suggested, however, that an outline of the investigation would be of interest to quite a number of engineers who would wish to keep in touch with the progress made and could, from their own experience, offer many helpful suggestions. What follows, therefore, should be considered only in the nature of an outline, together with a brief consideration of certain elements which it is believed may have an important bearing upon the subject.

In the first place shoving or tendency to shove is not an inherent characteristic of asphalt pavements, as evidenced by millions of square yards of satisfactory surfaces varying from one to forty years or more in age and subjected to all conceivable conditions of exposure and traffic. It is rather to be considered as an occasional manifestation which in many cases may be corrected by cutting out the deformation and replacing the old wearing course mixture with new, thus forming a patch. More often than not, when waves or deformations are noted in an asphalt pavement most of the adjacent surface in the same line of travel and with the same exposure is found to be true of contour. Except where failure of the foundation is evidently responsible, comparatively few cases are to be found where a high percentage of the wearing course even in the direct line of travel has shoved. It would, therefore, appear that where shoving occurs some condition or combination of conditions is responsible which if thoroughly understood would make it possible to prevent absolutely such defects in future construction.

Whatever the conditions are which make shoving possible, the primary cause of shoving is traffic, which produces a rearrangement of the mineral particles in the paving mixture to an appreciable depth from the surface down. On pavements which are sufficiently wide to allow two lines of traffic in each direction it will ordinarily be found that the formation of transverse waves is most prevalent near the gutter, where most of the horse-drawn and slow-moving-motor traffic finds its way. While it is probably true that the impact of fast-moving traffic will accelerate shoving, once started, or may be directly responsible where irregularities in contour first existed, comparatively slow moving heavily loaded vehicles are believed to be the predominating cause.

In addition to the formation of transverse waves, which seldom extend entirely across the road, rutting is sometimes noted. This is almost invariably due to the very close tracking of vehicles and usually extends for a considerable distance in two continuous parallel lines about as far apart as the ordinary spacing between the wheels of vehicles. Rutting is due to lateral displacement of the paving mixture, which seldom occurs in wave formation, although around curves and at intersections waves due to the side thrust of vehicles are sometimes to be found.

Certain general conditions which tend to promote shoving by producing an unstable paving mixture are quite well understood, but it is believed that there may be much yet to be learned regarding the limits of such conditions. These and other conditions are listed below for the purpose of illustrating the complexity of the subject from a research standpoint.

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*Paper presented at the 27th annual convention of the American Society for Municipal Improvements Baltimore, Md., Oct. 25-28, 1921.

†Chemical Engineer, The Asphalt Association.

Conditions which Tend to Promote Shoving

Foundation Faults:

1. Lack of support from below, causing local settlement of the foundation.
2. Uneven contour in foundation, causing variable thickness of asphalt paving mixture and consequent differences in compression.
3. Very smooth foundation, which may promote slipping of the asphalt paving mixture over its surface.

Inferior Paving Mixture:

4. Use of too soft an asphalt cement for the climate, traffic, or the grading of the mineral aggregate.
5. Use of too much asphalt cement in the paving mixture.
6. Poor grading of mineral aggregate, which creates instability of the paving mixture irrespective of the consistency and percentage of asphalt cement with which it is mixed.
7. Use of an excess of rounded particles of mineral aggregate in the paving mixture.

Construction Faults:

8. Uneven contour due to faulty spreading, raking or rolling of the paving mixture during construction, or lack of uniformity in the composition of the paving mixture.
9. Lack of proper initial compression during construction, which may be due to use of too light a roller, too little rolling, to the mixture being too cold when rolled, or too great thickness of course for a single rolling operation.
10. Faulty repairs to service openings.

Exterior Causes:

11. Absorption of an excess of oil or gasoline drippings, causing undue softening of the asphalt cement.
12. Gas leaks from main below the pavement structure, causing undue softening of the asphalt cement.

It is evident that a comprehensive investigation of the shoving of asphalt pavements must take cognizance of the factors just mentioned in arriving at any general conclusions. With this in mind it is planned to study this subject from a number of angles. To start with, existing pavements having the most complete history records available will be examined and samples taken from these pavements for complete laboratory tests. Already about 40 tentative locations have been selected in each of the five cities whose cooperation has been secured and samples of the pavements are being taken under the supervision of the U. S. Bureau of Public Roads. These locations have been carefully selected so as to obtain samples from the same pavement as close together as possible, where the surface shows (1) a marked hump, and (2) depression, and (3) an area of uniform contour, as well as from pavements which have shown no indication of shoving.

It was hoped that samples might be taken by means of a core drill mounted on a truck which would proceed from city to city until the entire lot had been secured. It was found, however, that the core drill could not be used successfully for this purpose and it was decided to cut out samples approximately 1 ft. square by means of an asphalt cutter and to saw each sample into four sections after it had reached the laboratory. The saw used for this purpose consists of a revolving carborundum saw having a steel center, to which is cemented a rim of carborundum and which is operated with a plentiful supply of water under pressure. From each large sample two small sections are to be examined by the municipal laboratory and two by the Bureau of Public Roads so that all results will be checked.

A comprehensive record sheet has been adopted for use in connection with each sample and in every case will be filled out as completely as possible. The sheet covers in detail five broad subjects: (1) general information, (2) specifications, (3) paving plant and construction record, (4) sampling record and (5) test record. The sheet was prepared primarily for use in connection with sheet asphalt and fine aggregate asphaltic concrete pavements, as it was thought advisable to limit the investigation for the time being to these types.

The laboratory tests on samples will consist of a determination of the density of each course of paving mixture and in some cases of the upper and lower halves of the wearing course. The samples will then be extracted with a suitable solvent to determine the percentage of bitumen and to recover the mineral aggregate for an accurate mechanical analysis and specific gravity determination. The bitumen will also be recovered for a determination of its specific gravity, but information relative to its consistency or penetration will be obtained either from the original municipal laboratory record or from a direct determination made upon an original file sample if it is available. While it is realized that the consistency of the asphalt may have changed during its service in the pavement, no reliable method has as yet been devised for ascertaining its consistency from a sample of extracted bitumen.

From the determination of specific gravity of the constituents of the mixture and the weight proportions in which they were combined, the maximum possible density of the mixture may be calculated and the actual percentage of voids in the pavement sample may then be ascertained by comparison with the density determination first made. By heating a portion of the original sample until it has softened to a sufficient extent it may be compressed to its maximum practical density in a mold, and by a comparison of the density of this specimen with its original density some idea may be obtained as to whether or not the pavement shows lack of compresson.

All test results will be carefully considered with respect to other data shown on the record sheets, including character and finish of foundation and character of subgrade, before any tentative conclusions are drawn. It is hoped that from examination of the pavement samples sufficient information will be secured to indicate the character of the paving mixtures which are most resistant to displacement under service conditions. If this can be done, it is then proposed to prepare laboratory specimens of compressed paving mixtures and subject them to a test for resistance to displacement. While all of the details of this test have not as yet been worked out, it is expected that specimens will be prepared with various mineral aggregates and asphalt cements, of different densities after compression and tested under carefully controlled temperature conditions with a device which is at present being designed by the Bureau of Public Roads to duplicate as closely as possible the shoving effect of traffic. When these tests are checked with the data obtained from the pavement samples it may be found quite practicable to develop a set of limiting conditions which will point the way to improvements in existing specifications or at least emphasize the necessity of more careful conformity with certain requirements of existing specifications.

Provided the reslts of such an investigation are sufficiently encouraging it is hoped to prove or disprove the conclusions which may be developed, by means of an accelerated service test on experimental sections of asphalt pavement laid on a large circular track over which an automobile truck will be run automatically for a sufficient length of time.

As previously stated this paper is only an outline of the investigation which is at present in its initial stages and it is hoped that engineers who are interested in the subject will feel free to discuss the proposed methods and offer suggestions or criticisms that may prove of value in perfecting the various details which are still to be worked out. All first reports of the results of the investigations will be issued by the Bureau of Public Roads which is directing the work. The Asphalt Association is of course greatly interested in the subject and the writer takes this occasion to acknowledge the courtesy extended him by the bureau in permitting him to present this outline to the members of this society.

Tests of Impact on Pavements by the Bureau of Public Roads—II[*]

Determination of Bearing Power of Subgrade—Determination of Moisture of Soils—Delivering Impact Blows—Autographic and Photographic Records—Levels for Deflection and Settlement

By C. A. HOGENTOGLER[†]

(Continued from November 16)

Method of Determining Bearing Power of Subgrade

Knowing that the resistance of a pavement is more or less dependent upon the support offered by the subgrade, it was desired, in connection with the tests on slabs, to secure information on the relative resistance to impact blows offered by the subgrades under the various slabs so that the behavior of the slabs under test might be more intelligently interpreted. For securing this information the deformations of the subgrade caused by blows from a small impact device were taken as an indication of the supporting value of the soil. This impact device consists of a steel rod and footing and a steel cylinder, riding on the rod, which can be dropped from any height, and thus deliver a blow to the soil through the footing. The rod, footing and cylinder weigh approximately 10 lb., and the footing has an area of about 15 sq. in. This device is shown in one of the accompanying illustrations.

At a point about the middle of each side of the slab under test, the soil was cleared away to the level of the top of the subgrade, after which the footing was placed on this level, care being taken to secure uniform bearing. The movable weight or cylinder was then dropped from a height of 3 ft., and the penetration was measured by means of an engineer's scale. Measurements were recorded for every drop up to the 10th, every 2d drop between the 10th and 20th, every 4th drop between the 20th and 40th, and after the 50th drop. After similar observations had been made on each of the four sides of the slab the data obtained were plotted on cross-section paper using penetration in inches and number of drops as coordinates. From the four curves thus obtained the record was completed by drawing a curve representing the average of the four. A typical record is shown in Fig. 1. Since it is desirable to know the relative bearing power of the soil throughout the time of test, the length of test and change of weather at times necessitated making several determinations.

Determinations of Moisture Content of Soils

In connection with the bearing power tests and at the same locations, samples of soil were taken for determining the moisture content. Four samples were taken at each point with a soil auger 1⅜ in. in diameter. The first sample was taken by forcing the auger down to a depth of 6 in. as indicated by a mark on the stem. The auger was then pulled up without turning, and the soil on it was pulverized or broken up and placed in a pint-size glass fruit jar and sealed; the point, depth, and jar number being recorded. The hole from which the sample was taken was then cleaned out thoroughly and the auger run down to a depth of 12 in. and a similar sample taken. Additional samples were taken at depths of 18 and 24 in. at each point.

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[*] From "Public Roads," the official publication of the Bureau of Public Roads, U. S. Department of Agriculture, October, 1921.

[†] Highway Engineer, Bureau of Public Roads, U. S. Department of Agriculture.

The samples were then weighed in the jars without tops or rubber gaskets to the nearest 0.1 gram and were then placed in an electric oven where they were heated for 24 hours at a temperature of about 120°C. It has been found that this will dry out the ordinary sample weighing 200 or 300 grams, and that tests show no loss of weight on further heating. After drying, the jars were again weighed as soon as they were cool enough to handle. The weights of the empty jars were kept on record so that the moisture content could be computed as soon as the dry weights were obtained.

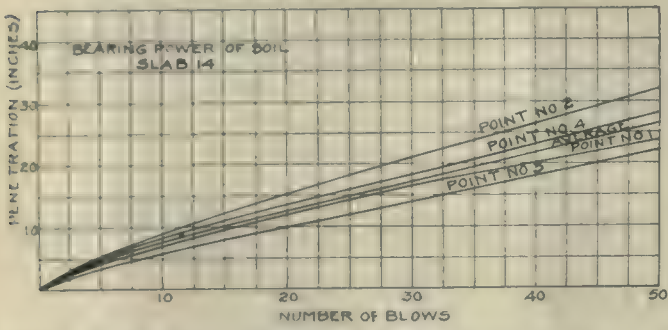

FIG. 1.—TYPICAL RECORD OF BEARING POWER OF SUBGRADE UNDER IMPACT BLOWS

The average of the contents shown by the six samples was assumed to represent the general moisture condition of the subgrade. More than one series of tests for moisture were made on slabs when length of test or weather conditions warranted.

Method of Delivering Impact Blows

In preparing to deliver impact blows the first step was to take a set of initial levels over the surface of the slab to be tested. The machine was then set up over the center of the slab and the frame raised or lowered by means of a screw jack, so as to allow a ⅛-in. drop. A space-time curve was taken of the first 5 drops at this height, after which the blows were continued until 250 had been delivered. A new elevation was then taken on the center of the slab and the machine was again set in motion for 250 more blows at the same height, taking a space-time curve for the first 5 drops. After the 500th blow levels were again taken on all points of the slab as described under "surface readings," after which the machine was set to operate at a height ⅜ in. greater, and the operations of delivering blows and leveling were repeated as for the first setting of the machine.

After 750, 1,250, 1,750 blows, etc., levels were taken only at the center points of the slabs; after 1,000 1,500, 2,000 blows, etc., they were taken on all points as described for the 500th blow. After each 500 blows the height of fall was increased ⅜ in., and the same setting of the machine was maintained for 500 blows. Thus at the beginning of the test and after 500, 1,000, 1,500, 2,000, 2,500 and 3,000 blows the height of fall was ⅛, ½, ⅞, 1¼, 1⅝, 2, and 2⅜ in., respectively. Slabs which did not fail before 3,000 blows, were given an additional 3,000 blows at the 2⅜-in. height; and if failure had not occurred as a result of these additional blows the effort to break them was abandoned. If the settlement of the slab after the first 500 blows was equal to or greater than ⅜ in., the drop was not increased for the second 500 blows. A center settlement of this amount generally indicated the beginning of failure.

Autographic and Photographic Records

The autographic space-time curves which were taken of the first 5 blows in each series of 500 and of the 5 blows succeeding the 250th, were taken for the purpose of securing information in regard to the behavior of the different factors influencing the force of the impact blow. Because of the vibration caused by the blow of the plunger the apparatus for securing the curves was mounted on a frame support which was entirely independent of the impact apparatus. The records were made by 4 brass points bearing against silicated paper which moved horizontally over a 5-in. drum at a rate recorded by means of an instrument designed to break electrical contact every second and thus cause a movement of the time recording point. The other three points trace the movements of the unsprung weight, the sprung weight and the slab vibration under the blow. These curves give all information concerning the force of the blow, the height of fall, the deformation of cushions, the relation of the movements of sprung and unsprung weight, etc. One of the illustrations in the preceding installment showed a typical autographic record.

For the purpose of comparing the behavior of the different slabs under test, photographs of both the surface and the base with the top course removed were taken immediately after the tests were completed.

Levels for Deflection and Settlement

In order to determine the effect of the impact blows upon the pavement slab under test, either in the way of general settlement or in the deformation of the slab or a combination of these two, it was necessary to have some sort of measurements made on the slab throughout the test.

Points for the reading of elevations were established at the center of the slab and at the corners and midpoints of the sides of concentric squares laid out on

(Continued on page 242)

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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Copy for advertisements must reach the New York office by noon on Tuesday of the week before date of issue if proofs are to be submitted.

Copy for classified and other advertisements where proofs are not required will be accepted until noon on Monday of the week of issue.

Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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AN OPPORTUNITY THAT ROAD BUILDERS SHOULD NOT NEGLECT

The road builder is a busy man—a man engaged in a work that demands all that he can bring to it of knowledge, skill and energy. And because this is so, it is essential to success that he keep abreast of the progress being made in the science and art to which he devotes his time.

Highway work is a branch of engineering in which development is particularly rapid. Though the basic materials the road builder uses are comparatively few and new ones rarely become available, methods are being modified continually and new and improved equipment is offered constantly. The up-to-date road builder derives most of his knowledge of current progress from technical literature. He also has recourse to inspection of the work of others and to discussion with other engineers and contractors engaged in work like his own. His opportunities for inspection and discussion, however, are necessarily limited.

His best opportunities for getting first-hand information are furnished by road conventions and engineering society meetings, especially when they include exhibitions of machinery and materials. First, he benefits from the papers and discussions at the meetings; second, he can inspect as thoroughly as he desires the equipment and materials exhibited, and last, but by no means least, he can meet men engaged in the same kind of work and discuss with them the problems that he has to solve.

Obviously, the convention that affords the best opportunity for the accomplishment of these three is the one at which the largest number of the leaders in the highway field are gathered and at which there is the greatest display of machinery and materials. In past years, the annual conventions of the American Road Builders' Association have met that specification. In January, 1922, that organization will hold a meeting and a road show at Chicago that now promises to surpass its previous efforts. Exhibition space has been taken at a rate that not only surely indicates a display that will include everything used by the road builder, but also makes practically certain an attendance that will include the foremost road builders of the country—officials, engineers and contractors.

The road builder who fails to attend the Chicago meeting will neglect an opportunity that, in justice to himself and to the public that employs him, he ought not to neglect.

Adverising on Nevada Roadsides under Ban The Nevada State Highway Department has declared war upon roadside advertising signs. Under a statute prohibiting the placing of such signs upon or over state highways, or within 20 ft. of the traveled portion of any such road, the department has announced its intention of proceeding against those who have begun to spoil the appearance of the new state roads.

Federal Aid Available at Last After an inexcusable delay, Congress has finally passed a federal aid law superseding that of 1916 and making a new appropriation. While the sum designated is less than had been hoped for, it is a substantial amount—especially when compared with past appropriations—and the ending of the uncertainty of the past months should go far toward giving new impetus to the demand for larger road building programs.

Slippery Road Surfaces It has been demonstrated time and again that most automobile accidents are caused by careless or unskillful driving. Only a comparatively few are due to road conditions, and although there are no figures at hand to prove the assumption, it is probable that a very large percentage of the accidents caused by the roads themselves are due to skidding on slippery surfaces. The prevention of all these is not a matter for the road builder, for some of the best and most popular road surfaces unfortunately do become very slippery when wet. At the same time, there are many slippery roads that would be far less dangerous were they not built with excessive crowns.

To Use Local Gravel in Choctaw County, Oklahoma

Recent tests of gravel in Choctaw County, Okla., show that it is of excellent quality and it is believed that by the use of this material for road building, the county can save $80,000 in freight.

It is estimated that the gravel necessary for the county's road projects, if shipped into the county, would cost $100,000. This expense can largely be eliminated by use of the newly discovered material. It is planned to build a short spur line from the Frisco to the proposed gravel pit, where there is said to be enough gravel for all the contemplated roads, for repair work, and for commercial purposes after the road work has been finished.

Indiana to Bar Roadside Advertising

Effective July 1, 1922, the Indiana State Highway Department will eliminate all advertising signs from the public highways except those carrying warnings or giving road directions. This action was particularly pleasing to M. E. Noblet, Manager of the Hoosier State Auto Association who with other officials of the association has long advocated the elimination of all advertising signs.

"Roadside signs are a record of dead-and-gone business firms," said Mr. Noblet. "Of course there are some that are not defunct but the stranger can't tell which is which.

"The Highway Commission's action should now be followed by similar action by every county board in the state. In case of big signboards placed away back from the road, no action can be taken, but signboards along the right of way and particularly the advertising signs at cross roads which don't give the motorists any direction information certainly should be barred. The live advertiser can best get his message across in the columns of his local paper, anyway."

HIGHWAY WORK IN 1921

U. S. Bureau of Public Roads Places Total Mileage for 1921 at 28,000

Road building has recovered from the setback received during the war, and prospects are bright for the future. Approximately 14,000 mi. of road have been constructed during the present season by the states in conjunction with federal aid, according to the Bureau of Public Roads, United States Department of Agriculture, and probably an equal amount independent of federal aid. More miles of improved road have been built than during any other year.

Costs of road grading and construction with local materials are down practically to the 1914 level. Some reductions, also, have been made in freight rates on road materials. The importance of this item is shown by the fact that in some cases it has been estimated that increased freight rates have added 10% to the cost of a road. Prices of manufactured road materials tend downward; the present level is materially lower than that of a year ago.

With the new appropriation by Congress of $75,000,000, added impetus will be given to new road construction. Many of the states are considering enlarged amounts of state aid, and the new law will have a tendency to encourage this policy. It will also secure the construction of a system of interstate and inter-county highways, rather than hap-hazard selection of roads as in some cases in the past.

The meeting of the Association of State Highway Officials to be held in Omaha, Neb., December 5 to 12, will be devoted largely to the discussion of ways and means of complying with the new law and getting construction under way.

ROAD WORK IN THE WESTERN STATES

Some $50,000,000 Being Spent for Highway Work, According to Statistics of the Asphalt Association

An unusual amount of road construction is under way in the West, according to the Asphalt Association, despite the prevalent business depression. The association's statistics, it is said, show that approximately $50,000,000 has been spent for highway work on the Pacific Coast this year.

California has fifty contracts under way, involving work that will cost nearly $10,000,000. The state is working on a state system of roads that embraces 5,560 mi., and 3,200 mi. have already been constructed. Motor vehicle license fees are used for highway work, and during the past fiscal year 619,680 motor vehicles were registered, bringing in a revenue of $6,134,741.

Montana has under way 28 projects that were carried over from last year and 21 new contracts have been awarded since the first of the year at a total cost of over $4,000,000.

Idaho has awarded only three state highway contracts this year, owing to delay in the sale of bonds. However, there are 18 highway contracts that were let prior to Jan. 1 that are under way and that will cost about $4,500,000.

Four large projects that will cost about $1,750,000 are under way in Nevada, and since Jan. 1 Arizona has let 9 projects that will entail a total expenditure of $750,000. In addition, in the latter state there are under way a number of conracts let last year. These involve a large mileage. Colorado has three contracts involving a total of about $3,000,000 under way, and New Mexico has awarded 25 contracts that will call for an expenditure of $2,000,000.

Oregon is spending about $9,000,000 this year on 118 road and bridge contracts. According to Chairman A. R. Booth of the State Highway Commission, the total expenditure for roads in the state will have reached the sum of $100,000,000 within the next decade, the distribution of cost being 25% to the Federal Government, 45% to the state and 30% to the counties. "Oregon already has expended $28,000,000 on road construction," according to Chairman Booth, "which, with contracts outstanding to the amount of $13,000,000, will make a total of $41,000,000 already applied. There are 4,500 mi. of road in the present state highway system and of this total 3,000 mi. have already been paved or graded."

CHAPIN ON THE NEW FEDERAL AID LAW

Automobile Manufacturer and Former Head of the Highways Transport Committee Sees Great Advance

The day when the Federal Government will take over the main interstate highways of the nation was brought measurably closer by the recent enactment of the Townsend Highway Bill, in the opinion of Roy D. Chapin, Chairman of the Highways Committee of the National Automobile Chamber of Commerce, according to a recent statement by that body, from which the following comment by Mr. Chapin is quoted:

"While the new highway act is not all that students of the question would like to see, the law as it now stands marks a distinct step forward in the evolution of our highway policy. Under its provisions, federal aid can no longer be scattered broadcast. Each state highway department is now compelled to designate 7% of the mileage in the state as a system, and of this 7% three-sevenths must consist of primary highways of interstate importance on which 60% of all federal funds may be concentrated. In those states where highway work is more advanced and where the state highway departments desire to concentrate more than 60% of their funds on the primary interstate roads they are permitted to do so, a clause which will enable some sixteen states to pursue the policy already adopted of building the most important roads first.

Will Stimulate Main Highways

"The immediate effect of this act will be to stimulate the construction and maintenance of the trunk highways in those states which because of lack of funds have not thus far made much progress toward an adequate system of connected highways. As this progress is made, the states themselves will undoubtedly come to the conviction already expressed by officials in the more advanced commonwealths that interstate highways perform more than a state purpose, are the most useful to the most people and logically should be constructed and maintained by the National Government. Presumably, this work would always be carried on through existing agencies of construction rather than through the organization of a federal agency, and the consequent release of state and county funds for the construction and maintenance of the state and county roads would greatly expedite completion of a network of highways everywhere.

Millions Saved in Equipment Costs

"With recognition of interstate roads now a fundamental principle in the national highway law, there are numerous other scarcely less important changes to be found in the new act. The new requirements for maintenance are so exacting as to insure the nation against loss and to set a high standard for the states. The same is true in the clause which provides that highways must be constructed with due regard for future as well as prevailing traffic needs. The new and flexible formula for public lands states will be far-reaching in its benefits as will the liberal appropriations for forest roads and trails which reach a total of $15,000,000 for the next two years. The clause which directs the Secretary of War to transfer to the Secretary of Agriculture surplus war materials available for highway use will effect a saving of millions of dollars in the purchase of equipment and will modernize highway methods of construction and maintenance everywhere.

"Another provision of far-reaching importance is that requiring that states must match federal funds with funds from state sources or so controlled, with a qualifying time limit of three years to permit necessary changes in state laws to meet these conditions. The broadened definition of a highway department will require proper organization of these important units in the future.

"The authority granted the Secretary of Agriculture to undertake highway research in cooperation with independent agencies as well as through the government will greatly stimulate study and analysis of fundamental highway problems.

Townsend Campaign Successful

"These are some of the main changes. There are others but sufficient have been enumerated to show that the educational campaign waged by Senator Townsend to bring about a clearer appreciation of the importance of the highway problem, has been a successful one."

Advertising Signs on State Highways

The sign fiend, who must deface every work of God and man with some sign calling attention to his particular line, has begun to make his appearance along the new state highways and deface every turn with a large sign and every guard rail with a spatter of paint. One zealous sign painter who proceeded to decorate a guard rail near Washoe City with a hotel advertisement will find that the sign has been removed, as will all others who try the same stunt, and the second offense will result in action other than the mere removal of the offending sign. The proprietor of this particular hotel has been notified to advise his artist to discontinue painting signs on guard rails, bridge railings, abutments, etc., or even placing such a sign within 20 ft. of the traveled way of the state highway. The state highway law has this provision relative to the

(Concluded on page 240)

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Crusher Run

Although there has been considerable snow, the contractors do not appear to be discouraged. Many of them are planning to stick to their work all through the month, if possible, and many hope to perform more or less excavation work during December.

State Commissioner of Highways Sisson recently delivered an address at the opening of the Ridge Road at Erie, Pa. Highway Commissioner Sadler, of Pennsylvania, Highway Commissioner Herrick, of Ohio, and Governor Sproul, of Pennsylvania, also participated in the ceremonies, at which over 15,000 people were present. The road extends from Erie to the New York State line.

Tuesday, November 29, has been designated by Commissioner Sisson as the date for the opening of the Rondout Creek Bridge. Governor Miller and former Governor Smith will speak and Ulster County officials are planning for a big event. The celebration will commence with a luncheon at the Kingston Armory at noon. Afterwards there will be a parade in which Kingston and Ulster County officials will participate.

It has been announced that the first section of the Oswegatchie Trail will be built next summer, and it is expected that the trail will be completed in five years. The trail will connect Carthage with Tupper Lake and as it will pass through one of the wildest sections of the Adirondacks, it is expected to be very popular with tourists. Two other Adirondack roads to be built next year are the Lake Titus-Duane Center Road and the Merrillsville-Clinton County Line Road.

Commissioner Sisson, First Deputy Sarr and Secretary Finch recently attended the opening of the Schuylerville-Gansevoort Road, connecting Schuylerville with Glens Falls.

At this writing there is considerable interest evident in the November letting scheduled for the 22d. The letting involves ten contracts with a total mileage of 37.41 mi. of construction and 11.48 mi. of reconstruction. The work is situated in Essex, Livinston, Orange, Otsego, Rockland, Schoharie, Sullivan, Ulster and Warren Counties. Seven of the roads are to have bituminous pavements and three cement concrete.

Advertising Signs on State Highways

(Concluded from page 239)

sign nuisance, which we intend to enforce to the best of our ability:

"Sec. 25. No advertising signs, signboards, or boards or other materials containing advertising matter shall be placed upon or over any state highway, nor within 20 ft. of the main traveled portion thereof; nor upon any bridge or other structure thereon; provided, that counties, towns, or cities of the State of Nevada may, by permission of the State Highway Department, place at such points as may be designated by the state highway engineer suitable signboards advertising such counties, towns, or municipalities. If any such sign is placed in violation of this act it is hereby declared a public nuisance and may be forthwith removed by the Department of Highways or its employees. Any person placing any such sign in violation of the provisions of this section shall be guilty of a misdemeanor and shall be fined not less than $10 or more than $50."—*Nevada Highway News.*

In Celebration of the Completion of a Road Contract from the village of Kandiyohi, Minn., to the Meeker County line, Contractor John McCusick recently tendered his employees and others a banquet which was followed by a dance. The hall was decorated in Halloween colors and a band supplied music. Brief addresses were made and Mr. McCusick expressed thanks for the hearty cooperation of his employees and the public officials. The road is 11 mi. long and the contract price was $351,728.

MEETINGS

Calendar of Coming Meetings

Dec. 5-12—American Association of State Highway Officials.—Annual meeting, Omaha; Neb. Secretary, John H. Mullin, St. Paul, Minn.

Jan. 17-20, 1922—American Road Builders' Association.—Nineteenth Annual Convention, Twelfth Americal Good Roads Congress and Thirteenth Good Roads Show under the auspices of the A. R. B. A., The Coliseum, Chicago, Ill. Secretary, E. L. Powers, 11 Waverly Place, New York, N. Y.

Motor Truck Association of America

At the November meeting of the association, which will be held at the Automobile Club of America, 247 W. 54th St., New York, N. Y., at 8:00 p. m., Nov. 29, there will be submitted a report of the proceedings of meetings held recently by the Joint Committee of the Legislature.

American Road Builders' Association

The annual meeting and "get-together" dinner of the American Road Builders' Association was held at the Automobile Club of America, New York, N. Y., on Tuesday, Nov. 15. Following the session of the board of directors at 3:00 p. m., the annual meeting of the members of the association was held at which the reports of the officers and committees were received. Officers for the coming year were elected as follows:

President, H. L. Bowlby, Chief of the War Materials Division, U. S. Bureau of Public Roads; Vice Presidents, Charles J. Bennett, State Highway Commissioner of Connecticut; Frank Page, Chairman, North Carolina State Highway Commission; A. R. Hirst, State Highway Engineer of Wisconsin; W. W. Crosby, National Park Service, Estes Park, Colo.; Secretary, E. L. Powers, Editor, "Good Roads;" Treasurer, Senator James H. MacDonald, Former State Highway Commissioner of Connecticut.

Board of Directors: A. W. Dean, Chief Engineer, Division of Highways, Massachusetts Department of Public Works; H. E. Breed, consulting highway engineer, New York, N. Y.; A. H. Blanchard, Professor of Highway Engineering, University of Michigan; G. P. Coleman, State Highway Commissioner of Virginia; M. J. Faherty, President, Board of Local Improvements, Chicago, Ill.; S. E. Bradt, former State Superintendent of Highways of Illinois; Fred E. Ellis, Peabody, Mass.; R. A. Meeker, Right of Way Engineer, New Jersey State Highway Department F. F. Rogers, State Highway Commissioner of Michigan; Fred W. Sarr, First Deputy State Highway Commissioner of New York; George W. Tillson, consulting engineer, La Grange, Ill.; W. D. Uhler, Chief Engineer, Pennsylvania State Highway Department; J. H. Cranford, Washington, D. C.; Austin B Fletcher, State Highway Engineer of California; W. A. McLean, Deputy Minister of Highways of the Province of Ontario, Canada; I. W. Patterson, Chief Engineer, State Board of Public Works of Rhode Island; W. R. Smith, Meriden Conn.; W. G. Sucro, Baltimore, Md.; H. K. Bishop, General Inspector, U. S. Bureau of Public Roads; John Swan, Pittsburgh, Pa.; M. F. Bramley, Cleveland, O.; F. E. Everett, State Highway Commissioner of New Hampshire; Samuel Hill, President, Washington State Good Roads Association; J. Frank Smith, Manager, Greater Good Roads Association of Kansas City; C. M. Upham, Chief Engineer, Delaware State Highway Department, and Acting Chief Engineer, North Carolina State Highway Commission; T. J. Wasser, State Highway Engineer of New Jersey.

Several changes in the constitution and by-laws of the association were approved, the most important being a change in the date of the annual meeting from November to May and a change in the method of electing officers. Under the new provisions officers will be elected from among the directors by the directors. Vacancies on the board will be filled each year by a nominating committee of seven selected from the board of directors. Another change makes the president eligible for re-election. By holding the annual meeting in May the new officers will have a longer time in which to lay plans for the annual convention and exposition. Arrangements were made to hold the next good roads congress and show at the Coliseum in Chicago, Jan. 17 to 20, 1922.

Following the dinner, the new president, H. L. Bowlby, discussed the future of the association and outlined plans to make the organization of greater importance and influence in the road building industry.

Col. J. W. Howard, Consulting Engineer, New York, N. Y., gave a reminiscent talk upon the early paving work in New York City, stating that Wall Street was paved in 1890 in response to a demand for the elimination of the noise arising from horse-drawn traffic.

Samuel Hill, President of the Washington State Good Roads Association, discussed the progress of highway development in this country. "The time has come for the United States to make a new departure," he said. "There are three forms of transportation in this country—railroads, highways and waterways. Unless we coordinate these three systems into one big system of transportation, each is more or less an economic loss."

George S. Bartlett, of the Universal Portland Cement Co., Chicago, Ill., urged the members of the association to go to Chicago to attend the annual convention and exposition, stating that Chicago would endeavor to do iself proud in the way of hospitality.

Mexican Good Roads Congress

A meeting designated as the National Good Roads Congress was held at Mexico City, Mexico, Sept. 5-11 The needs of the various states were discussed and recommendations were made for the financing of road construction.

It is stated that since the federal contributions from states and territories have been decreased by decree, it is proposed to require the states and territories to make up a part of the decrease by appropriating funds for road construction.

It is reported that the Mexican Government is to undertake extensive road building operations as a military measure and that American road machinery companies are already in the field.

First National Road Congress to Be Held in Argentina

A national highway congress is to be held in Buenos Aires in May, 1922, under the auspices of the Touring Club of Argentine. Representatives of the government and the principal engineers of Argentina will attend and a thorough study will be made of the roads of the country.

According to the Bureau of Foreign and Domestic Commerce of the U. S. Department of Commerce, it is believed that this congress will afford American manufacturers of road building machinery a good opportunity to place their equipment before Argentine engineers. This may be accomplished through reading matter and photographs and moving pictures, and by sending delegates to the meeting. Booklets, in Spanish, of rules and regulations for participants are being sent to the bureau's district offices at 734 Custom House, Boston, Mass., 504 Federal Building, Chicago, Ill., and 402 Third National Bank Building, St. Louis, Mo., where they may be seen by those interested.

PERSONAL MENTION

R. W. Cowan has been appointed city engineer of Macon, Ga.

John P. Leo has resigned as commissioner of street cleaning of New York City.

B. E. Clark, who has been serving as acting state highway commissioner of Oklahoma, has been appointed state highway commissioner.

Henry Negstad has been appointed county highway superintendent of Brookings County, South Carolina.

Roland A. Muenster, at one time city engineer of Austin, Texas, has been appointed assistant county road engineer of Bell County, Texas.

A. L. Luedke, Engineer-Economist in the U. S. Bureau of Public Roads, has been transferred to District 4, with headquarters at St. Paul, Minn.

John E. Johnson, a civil engineer of Paducah, Ky., has been appointed highway engineer for the western district by the Kentucky State Highway Commission.

A. A. Taylor, General Superintendent of the Department of Street Cleaning of New York City, has been appointed acting commissioner of street cleaning, vice John P. Leo, resigned.

Tests of Impact on Pavements by the Bureau of Public Roads

(Continued from page 236)

the slab. A bench mark was carefully set near by and readings were taken with a high-grade Y level. The level rod was made of a brass rod about 5 ft. long and ⅜ in. in diameter. To this a 12-in. engineer's scale was attached by an adjustable clamp which allowed the scale to be moved freely up and down the rod and then clamped firmly in place as desired. Readings were made on the edge of the scale which was graduated in 50ths of an inch, and by estimating 10ths a reading to within 0.002 in. could b eobtained.

The most troublesome sources of error were due to the failure of the rodman to hold his rod plumb and to irregularities in the slab surface at the points where the rod was placed. It was to overcome the latter trouble that the use of a small steel disk with a crowned upper surface was introduced. This disk, which might be more properly described as a hemisphere, was laid on its flat side over the points on the slab whose elevations were desired. As this disk was used on all of the points and throughout the test, no account of its thickness need be taken.

From the notes of the levels thus taken profiles of any section of the slab could be drawn and a series of these profiles for a given section was found to furnish a valuable means of determining the behavior of the section during the run of the impact test. By plotting the change in elevation against the number of blows, a curve is obtained that gives a basis for comparison between the different slabs. Curves of this type have been drawn for the center point on each slab and are kept as part of the record of the test.

(To be continued)

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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Concrete Roads
must be Reinforced

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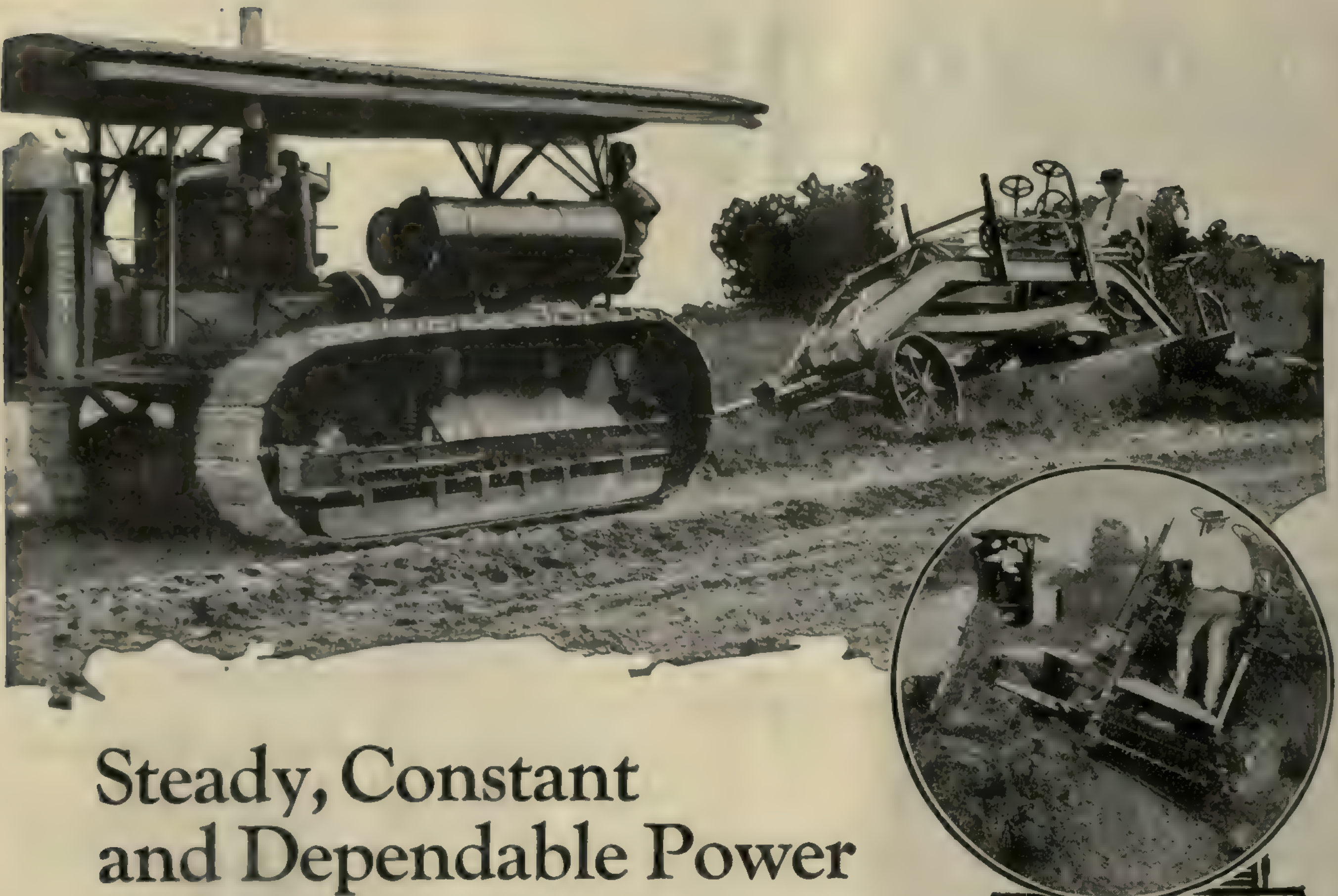

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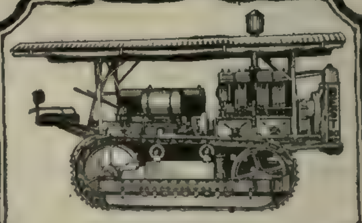

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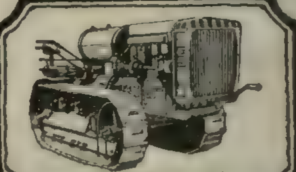

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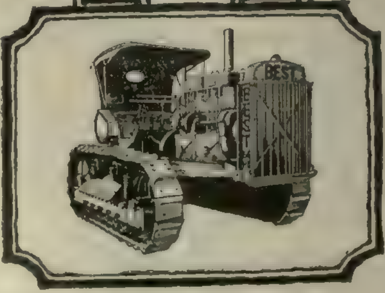

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GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

WITH WHICH IS INCORPORATED

THE HIGHWAY CONTRACTOR AND ROAD BUILDER

Vol. LXI. NEW YORK, N. Y., NOVEMBER 30, 1921 Number 22.

The Advantages of a Topographical Map in City Planning*

By JEFFERSON C. GRINNALDS†

It is a settled fact that a map of a city on which to study and lay out a plan for any proposed extension of the street system is necessary. It is a requisite, too, for replanning old parts of the city, to systematically study traffic conditions, to show offsets that break the continuity of streets, to show bad angles, block distances, dead end streets, inadequate widths and inefficient functioning of existing thoroughfares. A map of some kind on which to lay out a major street plan is absolutely necessary; and since zoning is an essential part of city planning, its requirements must be supplied, and maps are indispensable for a zone plan, indeed they are a part of it. There are many other reasons why a map of a city is necessary in planning.

Planning Without Sufficient Information

If it may be accepted as a condition precendent to studies for drawing a city plan that some kind of diagram of the present layout is necessary, then the kind of maps must be determined. Suppose those at hand are similar to the common well known automobile maps which show merely street alignment depicted to a scale of approximately 2,000 ft. to 1 in. or 1,000 ft. to 1 in. Of what service would a map of this kind be? If it were noticed that there were in some places two parallel streets which ran thus for, say 1,000 ft. or more without a connecting cross street, the city planner might say, "Why not open between these two parallel streets, a cross town street which is dead ended on opposite sides of this long unbroken block?" He can see from inspection of the diagram what seems to be a desirable opening. It is not apparent from such meager information that the grade on the proposed connection would be as heavy as 10%. Why? Because there were no elevations given nor were there contours showing approximately the probable grade. Imagine another problem that must be solved. Several parallel streets are shown on this diagrammatic map, crossing a railroad yard which lies contiguous to a railroad main line. There is no indication to guide the engineer in his diagnosis of the kinds of crossings over the tracks. Are they at grade, are they elevated above the tracks, or are they depressed below the tracks? If such crossings as exist are dangerous, what is the remedy? He cannot tell positively, with no more facts to help the solution. If he had a contour map which showed the relative locations to scale, he would know at once the conditions on the ground and where to look to find the railroad in a cut or on a fill where the streets could cross overhead or underneath, respectively. In one or both places he would advocate a bridge. Innumerable cases can be cited where it is absolutely necessary to have a topographic map showing contours and surface detail for study on which to base a comprehensive city plan.

Kind of Map Necessary

From the foregoing, it seems that a map is necessary and further that it should be a topographic map. Assuming that to be a correct conclusion, the next step is to determine what the map should show. The first consideration is the existing street layout. All streets that are built up or marked on the ground should be recorded by the field survey parties and plotted on the map. Old lanes and drives should be included. The office force should be employed at the same time, compiling all data accessible for platted parcels of land. Many such subdivisions have been laid out on paper with no streets having been staked off on the ground. All plots on record or of which any information can be obtained should be located on the field sheets when they come in. Improvements such as buildings of all kinds ought to be located on the field maps, including railroads, street railway lines, streams, shore line, lakes, reservoirs, retaining wals, dams, bridges, quarries and wooded areas. Fences and their character, such as wire, paling, rail or old fence lines, hedges and rows of trees that might indicate old property lines, are requisite to a good map. The state of cultivation is desirable, differentiating by suitable standard signs, orchards, meadows, plowed land, corn fields, pine woods, etc. Lastly, contours must be located and plotted.

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*Paper presented at the 27th annual convention of the American Society for Municipal Improvements, Baltimore, Md., Oct. 25-28, 1921.

†Assistant Engineer, City Plan Commission, Baltimore, Md.

Scales

Having decided what physical features are to be shown on the topographic map, it is necessary to determine the scale and contour interval. The former ought to be one which is readily plotted in the field on a field drawing table. When it is remembered that rows of brick houses are to be shown, it is not practical to draw them at a scale less than about 200 ft. to 1 in. To be able to scale within a foot or two the width of a street or sidewalk, the above mentioned scale is almost the minimum. The well known map of Baltimore, made by the Topographical Survey Commission of that city in 1894, is a masterpiece of that kind of work. It is drawn to a scale of 200 ft. to 1 in., with a contour interval of 5 ft. It was found to be admirably suited as a base for working out a plan for streets in the hitherto unplanned territory within the city. The contour interval of 5 ft. seems to be right for street design and determination of grades. It may be that over very flat terrain a lesser interval may be necessary for sewer design and to a less degree for water main locations.

Degree of Accuracy

Here it is well to decide how good the map must be from the point of view of accuracy. It should be based on a primary triangulation system, the stations of which may be regarded as nearly permanent and accurate to within ten seconds for closure of any quadrilateral. The secondary and tertiary stations should be almost as good as the primary. There ought to be one or two accurately measured base lines, corrected for curvature. On the triangulation there should be run out all the main roads and cross-country, a traverse control with a maximum error of 1 in 10,000 or 1 in 15,000. The reason for these standards of accuracy is that after such a map is complete, there is left on the ground a control from which detailed property surveys can be made, street intersections computed and established coordinately in the downtown districts where assessed land values are high. Traverse points should be iron rods or pipes placed in the most protected places along highways or in open country, or copper bolts set in curbs or on sidewalks, all well referenced for future use. A net of precise levels ought to be spread over the area to be mapped, bench marks being placed in the most permanent structures at about ½-mi. intervals. Wye levels can be run to traverse points and temporary stadia stations. Maximum error for precise levels should not be over about 3-16 in. to the mile.

Costly Errors Obviated

Why all this elaborate, detailed description of a map and what is the excuse for making it? Cities used to be laid out without one, it is true. What kind of a layout was it? Well, when a street was designed to be a straight street, it was so drawn on paper, so built on the ground and regardless of hills or ravines, it kept on. The costs heaped up for cuts and fills and bridges. If the way led to a railroad, it passed over at grade more than likely, leaving a heritage of danger for several generations, ultimately saddling the taxpayers with the burden of expenditures to eliminate at considerable cost, the death trap. Had a map been available, showing by contours the existing hills, valleys, streams, railroads, etc., it is probable that the entire street plan would have been different. When a large city of today was in the village or town stage, its whole scheme of streets would have been designed to fit the topography had proper maps been made. The present small town should benefit by the costly lessons that the large ones have learned too late to greatly alter the downtown sections without prohibitive cost.

Steps in Planning

Take the initial stage—suppose a new city is to be built on a proposed site. The topographic map is made. It is possible to determine at once certain rocky, precipitous cliffs, bluffs, wooded ravines, steep hillsides and other suitable areas for future parks. These may be eliminated from the flat or gently rolling terrain so well adapted to building and over which a street plan must be studied. The old country roads, shown on the map, are the existing highways of travel. Some may fit in with a general scheme and others will not. A study will reveal the natural location of the points of ingress and egress for railroads. They will not come into town over the hills. They will enter by certain low-grade lines and along them will be suitable territory for industrial development. On the higher ground it will be the housing area. It is necessary to determine where the central business area should be. These various districts must now be connected. Radials from the center of town to the outlying sections must be provided. Crosstown and circumferentials must be provided. These streets are the basis for a major street plan. They need not be absolutely straight. The alignment may be determined by the contour of the ground, thereby giving easy grades but with the most direct route consisent with reasonable grades.

New Territory to Be Laid Out and Old City Replanned

An old city that requires a plan for undeveloped or recently annexed territory, and that needs replanning in built up portions, requires a topographic map. In almost every city of that type the street plan was drawn on a flat diagrammatic map. With the general information shown on a complete topographic survey, it is well to work out proposed extensions of the park system, reaching out into the undeveloped country, embracing the ravines, etc., and certain other land suitable for parks. These may then be connected by proposed parkways. These areas being determined, it is unnecessary to lay them off into streets. The city plan is simplified to that extent. The major street plan may be laid down on broad lines. Existing grades may be corrected. Slight alterations may serve to give good results. Certain sharp curves may be eased up by curves of longer radii and offsets may be cured by cutting off some corners. The buildings being shown, studies of the cost of widening may be made and where it is necessary to accommodate the present or future traffic, a new building line may be determined and fixed. The map gives a good idea of the kind of improvements situated within the new lines. In the old parts of town the elevations may show a major street to be necessary on a high grade and not far distant a low grade artery may be indispensable. Provision can be made for connections between the two. In outlying territory, similar conditions may prevail. In the absence of a contour map this could not be seen without a close inspection of the ground and even then the exact locations could not be made unless a survey were available.

Efficiency and Economy

The old checker board street systems are not practicable, efficient or economic over rolling country. Once upon a time that was the only practice. Closer study with broader information at hand and more intensive efforts at scientific planning have tended to make a street plan more nearly fit the natural ground. Some cuts and fills can not be avoided but they can be reduced in number and in magnitude, by a more rational layout which is not only less costly by being more readily adaptable to the surface, but after all it is more beautiful. The monotony of the long uninteresting city streets so common in all cities will give way to the gently curving and sometimes winding park-like road. A contour map is the best possible guide for the city planner. It is likewise a guide to those who would develop land for sale as lots. They can see from such a map how best to make a street layout involving the least expenditure for grading and giving the best street connections. New streets can be made coterminous with those already existing or a good reason for not doing so will usually appear on the map showing contiguous property. Much money can be saved to the city and to the land owners by the use of a good survey, and its cost will be returned many times. Indeed, grading cost alone on one or two of the existing main highways of some of the large cities has amounted to more than a topographic map would cost and, had it been available, the alignment might have been different, avoiding part of the outlay for grading.

Grade Crossings Avoided

Outside of what we might call the congested part of town and farther toward the outskirts, major streets may be laid out almost a half mile apart and crossings of railroads and deep gullies may be situated at about 5-mi. intervals. These railroad crossings can be readily determined by studies of the topography. It may be found that where the road is in a cut or fill, there is the logical place to cross instead of at grade any old place, as they used to do. The writer emphasizes the grade crossing menace and its abolishment by proper study, because it is so prevalent in all towns.

Sewer Design Depends on Topography

No other feature of city building depends more on the topography than the sewers. The $20,000,000 expended on a comprehensive sewerage system for Baltimore was based entirely on the map of 1894. On it the natural drainage could be traced and the storm water sewers followed it. The drainage area could be readily computed and the size of mains determined. Sanitary sewers were designed, too, from study of the surface as surveyed by reasonable deductions as to the use to be made of certain kinds of land. Grades, too, were an important factor. Water mains are more easily located by having a map showing all physical features so that the pipes may conform to the hydraulic gradient and the areas they are to serve will have their bearing on the size.

Rapid Transit

For thorough study of a proposed rapid transit system, a topographic map is essential. Elevations of streets, railroads and streams will give a clear conception of what levels the underground system will have to meet. If an elevated structure is necessary the same data is available and where the way may be in open cut on the surface, or on fill, safe and properly located crossings will be situated at suitable intervals.

Correct Base Map for Zoning

Since zoning is a part of city planning, inquiry as to the kind of map on which to base zoning studies is apropos. It seems necessary to have a correct and complete representation of all present conditions. The buildings must be shown in order to draw clearly in detail an existing use map of the city to be zoned. A good base map would show on inspection that the buildings are of frame, brick, or stone construction. It will appear that some of the buildings are attached, that is, built in rows without side yards. Others will appear to be of the type known as semi-detached houses built in pairs, joined on one side with one side yard to each unit of the couple. Detached houses with two side yards to each house will be noted. Such a map as has been recommended above will show the buildings which sit back from the front lot line and those that are built up to the street line. The fundamental maps on which zoning studies are based can readily be prepared. It will be easy to

(Continued on page 250)

Tests of Impact on Pavements by the Bureau of Public Roads—III.*

Necessity for Calibrating the Impact Machine—Cushioning Effect of the Copper Cylinders—Character of Copper Unchanged by Impact

By C. A. HOGENTOGLER†

(Continued from November 23)

Necessity for Calibrating the Impact Machine

As stated in the beginning, these tests were inaugurated principally for the purpose of making available information which would add in the intelligent selection of a pavement. For this purpose the resistance of the slabs is given in terms of the height of fall of the wheel of a loaded 5-ton truck required to produce failure. With this general information it is necessary only to determine the maximum drop due to obstructions, character and condition of surface, use of chains, etc., and then select from the table a pavement that will resist the wheel load falling from that height. This method of selection, however, is not very scientific and can be considered only as a preliminary step. In the attempt to supply an improved method the impact blows have been expressed in terms of equivalent static loads, and the resistance of the slabs in terms of the static load equivalent to the impact which caused their failure. Knowing, then, the kind of traffic to be accommodated, and finding from the data furnished by the truck impact tests, *.* the equivalent static force which can be expected from traffic, it is only necessary to select a surface that will safely resist the required force.

Stating the impact in terms of equivalent static load necessitated the calibration of the impact machine. In order that a comparison could be made between the effects produced by impact blows and static loads some medium was required upon which the effects produced by both kinds of force could be observed. The medium used to afford the desired comparison was a ½x½-in. annealed copper cylinder similar to those used in the impact motor truck tests. By first noting the deformations produced on these cylinders by given static loads, then comparing with these static deformations the deformations of other cylinders produced by the impact blows, a comparison of the effects of impact and static forces was secured. The calibration of the impact machine then included (1) the determination of the static loads which would produce the same deformations on copper cylinders as were produced by the plunger of the impact machine falling from different heights, (2) the determination of the equivalent static loads corresponding to the fall of the plunger from different heights when the cushioning effects of the copper cylinder's deformation were eliminated, and (3) the development of a method of determining the equivalent static load from the space-time curves which were secured during the tests on the different slabs.

For determining the static load which produced the same effect as the plunger dropping from different heights a jack similar to that described in the report of the truck impact tests was used. During January, 1921, when the subgrade under the slabs was frozen, the impact machine was set over slab No. 15 and the jack in which the copper cylinders were to be deformed was placed under the plunger. The machine

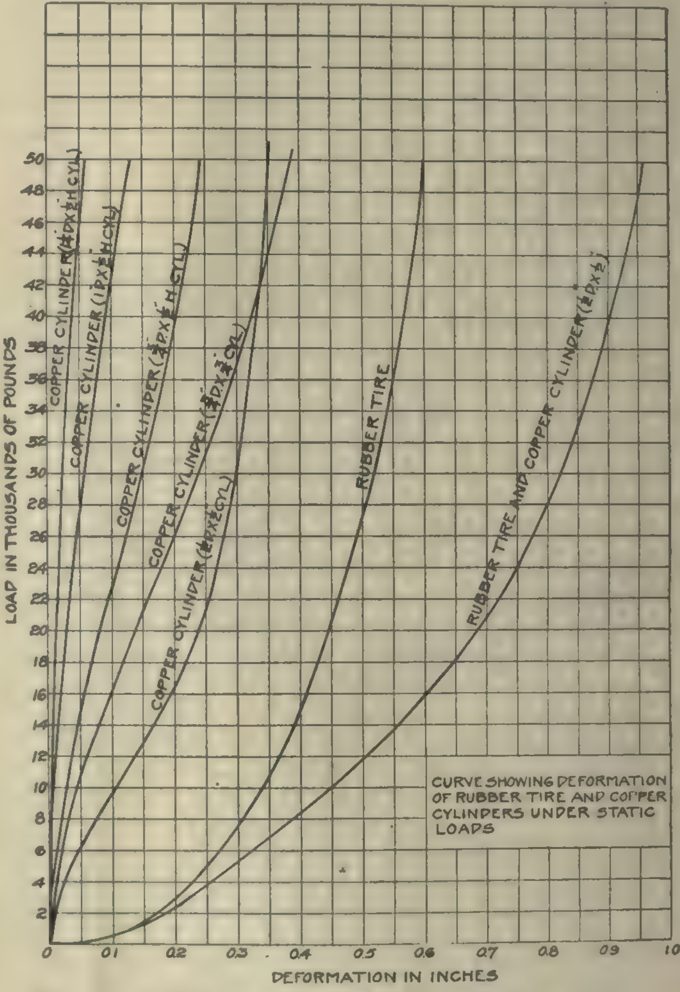

FIG. 2—DEFORMATION OF RUBBERTIRE AND COPPER CYLINDERS UNDER STATIC LOADS

was loaded with sprung and unsprung weights of 6,000 and 2,000 lb. respectively. Deformations of the copper cylinders were secured for heights of fall of the unsprung weights ranging from 1 to 3 in. as measured by the space-time curves which were taken for each drop. With these deformations the equivalent static load was found from the calibration curve for ½x½-in. cylinders, shown in Fig. 2. The data for this curve were secured by subjecting cylinders to static loads of from 0 to 50,000 lb. in an Olsen 200,000-lb. testing machine and recording the corresponding deformations. The equivalent static loads found for the different drops are given in Table 7. It will be noted that height of fall as used in this connection means the distance from the highest position to the final resting place of the plunger.

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*From "Public Roads," the official publication of the Bureau of Public Roads, U. S. Department of Agriculture, October, 1921.

†Highway Engineer, Bureau of Public Roads, U. S. Department of Agriculture.

**See "Public Roads," vol. 3, No. 35.

TABLE 7.—EQUIVALENT STATIC LOADS AND MAXIMUM FORCE FOR IMPACTS FROM VARIOUS HEIGHTS OF FALL, AS MEASURED BY ½x½-IN. COPPER CYLINDERS.

No.	Free fall (H. F.).	Unsprung wt.+avg. spring pressure (w+f).	Total height of fall (h).	Total cushion (d),	Equivalent static load.	Maximum force (computed).	Ratio equivalent static load to max. force.
	Inches.	*Pounds.*	*Inches.*	*Inches.*	*Pounds.*	*Pounds.*	*Per cent.*
1	0.77	7,100	1.187	0.719	22,500	23,400	104.0
2	.78	7,125	1.176	.700	21,700	23,900	110.0
3	.97	6,900	1.440	.776	26,300	25,600	97.5
4	.97	6,925	1.432	.766	25,600	25,840	101.0
5	1.33	6,575	1.848	.823	29,750	29,500	99.3
6	1.41	6,525	1.920	.814	29,150	30,760	105.5
7	0.30	7,600	0.536	.534	13,700	15,260	111.5
8	0.33	7,550	0.580	.553	14,450	15,850	109.7
9	0.20	7,700	0.380	.380	12,100	14,700	129.02
10	0.15	7,750	0.344	.344	11,900	13,600	114.0
11	0.69	7,150	1.088	.688	20,775	22,600	109.0
12	0.64	7,200	1.016	.674	20,050	21,700	108.0
13	0.92	6,950	1.352	.731	23,300	25,720	110.0
14	0.84	7,050	1.260	.718	22,500	24,740	110.0
15	1.09	6,800	1.552	.766	25,000	27,560	110.0
16	....	....	....	....	....	....	....
17	1.11	6,775	1.568	.764	25,500	27,780	109.0
18	1.47	6,500	1.972	.801	28,050	32,000	114.0
19	1.50	6,475	1.988	.793	27,500	32,440	118.0
20	....	....	....	....	....	....	....
21	....	....	....	....	....	....	....
22	1.97	6,100	2.500	.835	30,650	35,220	118.0
23	2.01	6,100	2.552	.842	31,300	36,940	118.0
24	2.25	5,850	2.800	.851	32,050	38,500	120.0
25	2.28	5,850	2.840	.859	32,900	38,700	117.5
26	2.70	5,500	3.260	.867	33,650	40,660	121.0
27	2.54	5,600	3.102	.862	33,200	40,300	121.5
28	....	....	....	....	....	....	....
29	3.00	5,250	3.568	.874	34,350	42,400	123.5
30	3.31	5,000	3.884	.879	34,850	44,300	127.0
31	3.30	5,000	3.872	.878	34,700	44,000	126.7
32	3.04	5,100	3.608	.875	34,400	42,000	122.0

Unsprung weight (w)=2,000 lb. Sprung weight=6,000 lb.

Equivalent static load determined from ½x½-in. copper cylinders.

Average F. for free fall (H. F.) of from 1 to 3 in. is 120.5 % of equivalent static load.

Average F. for free fall (H. F.) of from 0 to 1 in. is 104.5% of equivalent static load.

Cushioning Effect of the Copper Cylinders

While the results from the above investigation were better than nothing, it was realized that they did not give the required information. The calibration of the impact machine was undertaken to determine the effect of the drop of the plunger from different heights on the various slabs, whereas the results obtained by these means showed the effect of the plunger dropping on a copper cylinder, which is a somewhat different matter.

The main difference between static force is entirely dependent upon the weight of the load, while the impact force produced by a mass moving with a given velocity is dependent upon the time or distance in which the velocity of the mass is changed or brought to zero. That is, an impact force is dependent upon the deceleration of the given mass which is dependent upon the character of the body struck as well as of the striking mass. When two bodies, each highly resistant to deformation, are brought into contact the force is exceedingly high. The effect of any cushion is to increase the time in which change of velocity occurs and consequently to reduce the deceleration. For this reason it can be seen that the copper cylinder used in the calibration is, in effect, an additional cushion between the plunger and the slab, and the force of the blow causing a certain deformation of the copper cylinder would be greater if the cushioning of the blow due to the deformation of the copper could be eliminated.

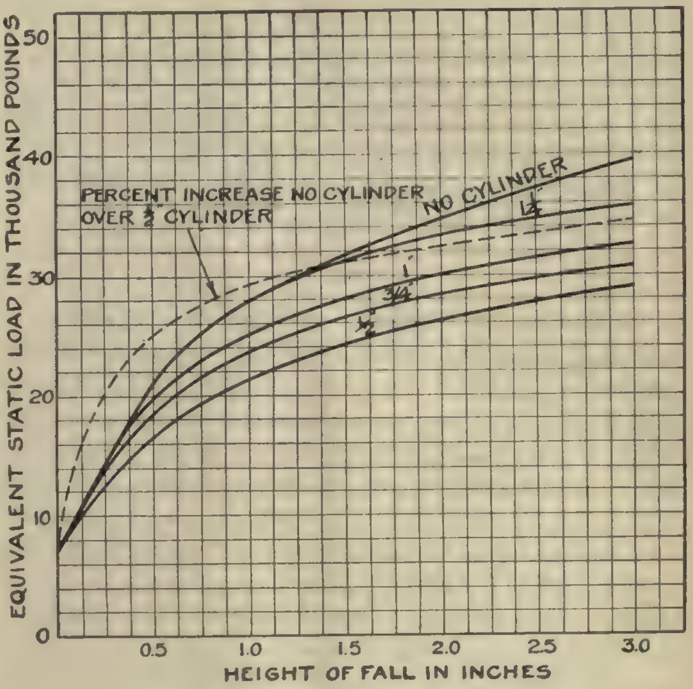

FIG. 3.—CURVES SHOWING CUSHIONING EFFECT OF COPPER CYLINDERS OF THE SEVERAL SIZES

It therefore became necessary to determine the effect of the copper cushion; and the most convenient means which suggested itself for a study of the effect of reduction of copper cushion was by repeating a blow on the same cylinder. When this was tried it was found that the second drop from the same height produced an additional deformation smaller than the first. A third drop from the same height produced a further but still smaller deformation. Continuing the process it was found that each succeeding blow from the same height produced a smaller deformation than the preceding, but each blow nevertheless produced additional deformation. Now, it had been found previously that cylinders which had been subjected to static load in the testing machine, if retested, were not deformed further by any load less than or equal to the load under which the original deformation took place; and it was not until the second application of load exceeded the first that further deformation resulted. The coupling of this observation with the observed effects of repeated impact seemed to indicate that the blows which caused the succeeding deformations were equivalent to greater static loads than the first blow. Moreover, it appeared that there was a definite relation beween the amount of the deformation and the intensity of the blow. Considering the copper cylinder as a cushion, it appeared that reduction of the deformation or cushioning effect of the blow increased its static equivalent.

Character of Copper Unchanged by Impact

It was suggested at this point that the deformation caused by the first blow might change the character of the copper so that the results of the succeeding blows would not be true indications of the force. To secure light on this phase of the matter different cylinders which had received from 5 to 50 blows were subjected to additional static loads in a testing machine and the corresponding deformations were compared with those shown by the calibration curve in Fig. 2. It was found that the variation was less than 1%, thus indicating that the character of the copper had not changed as a result of the deformations occasioned by impact blows. Also, at this time, it was found that there was an elastic deformation of the copper cylinder which amounted to slightly less than 0.01 in. under a 50,000-lb. load, but this elastic deformation does not enter into any of the derivations herein described. When it was concluded that the deformation of the copper influenced the force of the blow, the following investigation was carried on for the purpose of securing definite information on the effects of reduction of copper cushion.

Knowing that under the same load and for the same height of cylinder the deformation decreases with an increase in area, copper cylinders of different diameters were prepared for a second calibration of the impact machine. A special concrete foundation 4 ft. in diameter and 2 ft. thick was constructed to hold the jack.

The different sized cylinders as well as the cast-iron shoe and rubber tire of the plunger were carefully calibrated in a testing machine, and the results are shown by the curves in Fig. 2. The machine for this run had for sprung and unsprung weights 6,000 and 1,800 lb., respectively, the same as the loading which was used in testing all of the slabs. The procedure in obtaining copper deformations for the various heights of fall was similar to that followed in the first calibration, except that the height of a fall was checked by means of precise levels, that copper cylinders of different sizes were used, and also that in this run every observation, both static and impact, was made by two men, one reading and the other checking. The results obtained are shown in Table 8 and by the curve in Fig. 3. These results show very definitely the increase of force with the decrease of copper deformation.

TABLE 8.—EQUIVALENT STATIC LOADS AND MAXIMUM FORCE FOR IMPACTS FROM VARIOUS HEIGHTS OF FALL AS MEASURED BY COPPER CYLINDERS OF DIFFERENT SIZES.

No.	Free fall (H.F.)	Unsprung weight +avg. spring pressure (w+f).	Total height of fall (h).	Total cushion (d).	Copper cylinder.	Equivalent static load.	Maximum force (computed).	Ratio equivalent static load to maximum force.
	Inches.		*Inches.*	*Inches.*	*Inches.*	*Pounds.*	*Pounds.*	*Per cent.*
2-1	0.490	0.7125	0.844	0.654	½ by ½	16,200	18,400	113.5
2-2	.495	.7180	.812	.617	½ by ½	17,300	18,900	109.0
3-1	.482	.7110	.872	.690	½ by ½	16,350	18,000	110.0
3-2	.496	.7200	.784	.598	½ by ½	17,400	18,880	108.4
3-3	.494	.7200	.784	.590	½ by ½	17,900	19,120	106.8
No Cyl.	.532	.7125	.856	.624	....	....	20,640	....
4-1	1.097	.6500	1.696	.899	½ by ½	21,700	24,500	113.0
4-2	1.093	.6600	1.532	.739	½ by ½	23,700	27,400	115.5
4-3	1.067	.6600	1.518	.781	½ by ½	25,300	26,160	103.3
5-1	1.090	.6500	1.712	.922	½ by ½	22,600	24,140	106.7
No Cyl.	1.124	.6575	1.564	.740	....	....	27,760	....
6-1	1.675	.5950	2.416	1.041	½ by ½	25,000	27,560	110.0
6-2	1.711	.6125	2.180	.769	½ by ½	27,700	34,740	125.0
6-3	1.724	.6125	2.184	.760	½ by ½	28,700	35,200	122.5
7-1	1.680	.6000	2.368	.988	½ by ½	25,500	28,760	112.5
No Cyl.	1.696	.6125	2.184	.788	....	....	33,920	....
8-1	2.280	.5450	3.052	1.072	½ by ½	26,500	31,000	117.0
8-2	2.311	.5550	2.956	.945	½ by ½	30,200	34,690	115.0
8-3	2.289	.5550	2.936	.947	½ by ½	31,600	34,[illegible]60	108.5
16-1	2.811	.5000	3.626	1.115	½ by ½	28,600	32,540	113.8
16-2	2.820	.5150	3.454	.931	½ by ½	32,900	38,100	116.0
17-1	2.813	.5000	3.652	1.139	½ by ½	29,000	32,100	110.5
18-1	2.585	.5250	3.352	1.067	¾ by ¾	28,900	33,100	114.5
18-2	2.533	.5350	3.208	.975	¾ by ¾	32,100	35,220	109.7
18-3	2.532	.5350	3.198	.966	¾ by ¾	33,600	35,380	105.2
19-1	....	....	....	....	....	29,300	....	....
20-1	2.027	.5700	2.730	1.003	¾ by ¾	27,200	30,980	113.8
21-1	1.363	.6300	1.960	.897	¾ by ¾	24,200	27,540	113.7
21-2	1.378	.6400	1.842	.764	¾ by ¾	26,500	30,900	116.5
21-3	1.387	.6400	1.848	.761	¾ by ¾	27,700	31,080	112.0
22-1	.811	.6850	1.208	.697	¾ by ¾	20,500	23,720	115.5
23-1	1.100	.6650	1.584	.784	¾ by ¾	22,800	26,900	118.0
24-1	.487	.7175	.840	.653	¾ by ¾	17,200	18,460	107.1
24-2	.495	.7200	.800	.605	¾ by ¾	18,300	19,060	104.0
25-1	.272	.7400	.532	.532	¾ by ¾	13,200	14,060	106.5
26-1	.288	.7375	.556	.556	½ by ½	12,300	14,420	117.0
No Cyl.	.304	.7450	.468	.464	....	....	15,050	....
51	.427	.7250	.692	.565	¾ by ½	16,600	17,760	107.0
52	.412	.7225	.708	.596	1 by ½	17,200	17,140	99.7
53	.408	.7275	.686	.578	1¼ by ½	17,800	17,260	97.0
54	.641	.7050	.976	.635	¾ by ½	20,800	21,660	104.0
55	.653	.7050	.956	.603	1 by ½	22,000	22,360	101.5
56	.724	.6900	1.152	.728	1¼ by ½	22,600	21,840	96.7
57	1.151	.6500	1.672	.821	¾ by ½	24,600	26,500	107.5
58	1.176	.6550	1.600	.724	1 by ½	26,600	28,960	108.7
59	1.147	.6600	1.576	.729	1¼ by ½	29,400	28,540	97.0
60	1.733	.6000	2.372	.939	¾ by ½	27,100	30,340	112.0
61	1.740	.6050	2.256	.816	1 by ½	28,800	33,400	116.0
62	1.716	.6050	2.240	.824	1¼ by ½	32,600	32,900	101.0
63	2.283	.5500	3.024	1.041	¾ by ½	28,450	31,960	112.0
64	2.234	.5550	2.904	.970	1 by ½	30,600	33,300	109.0
65	2.225	.5600	2.840	.915	1¼ by ½	33,800	34,760	103.0

Unsprung weight, 1,800 lb. Sprung weight, 6,000 lb.

Average Ratio of Equivalent Static Load to Maximum force for Different Heights of Fall

Copper cylinder	Free fall (H. F.) Inches	Average ratio Per cent.
½ by ½ inch....	1	112.4
Do........	2	113.1
Do........	3	110.3
¾ by ¾ inch....	1	112.7
Do........	2	110.0
Do........	3	108.6

Average Ratio of Equivalent Static Load to Maximum Force for All Heights of Fall

Copper cylinder	Average ratio Per cent.
½ by ½ inch....	112.7
¾ by ¾ inch....	111.4
¾ by ½ inch....	108.5
1 by ½ inch....	106.9
1¼ by ½ inch....	98.9

(Continued on page 252)

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

Founded January, 1892

E. L. POWERS
Editor

T. A. HULBERT
Managing Editor

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Copy for advertisements must reach the New York office by noon on Tuesday of the week before date of issue if proofs are to be submitted.

Copy for classified and other advertisements where proofs are not required will be accepted until noon on Monday of the week of issue.

Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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Vol. LXI November 30, 1921 No. 22

TOPOGRAPHIC MAPS FOR CITY PLANNING AND OTHER PURPOSES

In an article printed on other pages of this issue, J. C. Grinnalds, Assistant Engineer with the City Planning Commission of Baltimore, Md., sets forth numerous reasons for the preparation of topographic maps for use in city planning.

Such maps are of great use—if, indeed, they are not indispensable—in laying out streets and parkways, sewerage and transit systems, and in zoning, according to Mr. Grinnalds. He holds that much costly municipal work could be avoided by their use, citing the designing of Baltimore's sewerage system as an example of the saving of nearly a quarter of a million dollars.

It is evident, as he points out, that a map of a city is necessary to the study involved in making street layouts. And he clearly demonstrates that the kind of map needed is a topographic map based upon an accurate system of triangulation and precise levels The degree of accuracy specified probably would not be required in most of the smaller cities; each case would have to be determined with a view to local conditions.

While engineers generally would agree with Mr. Grinnalds' contentions, it probably would be a quite difficult matter to persuade lay officials and the public that the expense of preparing a map was justified. The task of doing so, however, is distinctly one for the engineers to take upon themselves. Every engineer knows that in most cases the cost of the work would be returned to the city many times through savings effected.

Every engineer knows, too, from bitter experience, that one of the most difficult tasks in the world is persuading a man or a body of men that a certain course of action involving the spending of a dime will later result in the saving of a dollar. This knowledge, however, is not a valid excuse for shirking a disagreeable duty.

Farmers Want Good Roads It used to be a thankless job to "preach the gospel of good roads" to the farmer. He looked upon the hard road as nothing more than a plaything for the city dweller, and resented having to help pay for it. But the farmer has been converted. With a country-wide average of more than 3 cars and 2 trucks to every 100 farms, and with an average in 8 great agricultural states of 50 passenger cars to each 100 farms—to say nothing of the farmers who enjoy the benefits of motor transportation without owning vehicles themselves—so intelligent a citizen as the farmer can no longer oppose highway betterment.

Massachusetts Prepares for Next Year The Division of Highways of the Massachusetts Department of Public Works has made plans for the improvement of some 87 mi. of roads next year and has sent out to contractors a list of the proposed projects, together with a letter calling attention to the work and suggesting the making of preliminary investigations in preparation for the submission of proposals when the jobs are advertised. The same plan was followed a year ago and, according to the department officials, to it "can undoubtedly be credited a portion of the satisfactory results secured in carrying on the work of 1921, which is now practically completed."

Maintenance Problems in England English roads are still suffering from the curtailment of maintenance during the war, according to "The Surveyor," a British engineering weekly. In the issue of November 11 attention is called to reports from county surveyors of Kent and Northamptonshire in which the question is discussed in some detail. In Kent much progress has been made in getting the highways back into shape, but the unprecedented increase in traffic has indicated that some form of restriction and control will be a necessity. In Northamptonshire, "It is said that no prospect of any sustained improvement of the roads is as yet in sight." An editorial concludes with the observation that: "The lesson to be learned is that delayed expenditure on road maintenance is not economy."

MASSACHUSETTS PREPARES FOR NEXT YEAR'S ROAD WORK

Division of Highways of the Department of Public Works Sends Contractors Data on Proposed Program

The subjoined letter sent out to contractors by the Division of Highways of the Massachusetts Department of Public Works shows what that state is doing towards preparing for an early start on the 1922 road building program.

"A year ago the Department of Public Works, Division of Highways, inaugurated the plan of having contractors make preliminary investigations of work to be undertaken the following season. To this move can undoubtedly be credited a portion of the satisfactory results secured in carrying on the work of 1921, which is now practically completed, and in connection with which the department desires to record its appreciation of the generous cooperation on the part of all contractors.

"In planning the work for 1922, progress has been made by the department so that many projects are practically decided upon and plans have been sufficiently advanced to inform contractors relative to engineering requirements for their preliminary study. It is desired that contractors who are interested in highway construction for this department in 1922 should immediately get in touch with the chief engineer, learn of projects definitely decided upon, be advised as to location and amount of work proposed, and supplement such information by their own investigations at the different locations. This preliminary investigation is expected to place contractors in a position to submit intelligent bids early next spring and thus aid in securing an early start on construction work for the season.

"It is also to be understood that such specifications as are furnished at this time are contingent upon final determination by the commissioners and in submitting final plans for bids, the type of surface and character of construction may be changed. For this reason, it is suggested that investigation by contractors should contemplate the different types of standard construction and surface that now prevail in the department, with due regard for all materials and elements that may be involved."

The projects now included in the 1922 program, as given out by the department, comprise approximately 87 mi. of road and 3 concrete bridges. Of the total road mileage, about 47.5 mi. consist of construction, about 33 mi. are reconstruction and one project, about 6.5 mi. in length, is construction and reconstruction. Practically all of the construction work calls for bituminous macadam surface, while the greater portion of the reconstruction work contemplates the laying of cement concrete surface. Of the 47.5 mi. of construction, about 3.7 mi. are to be of cement concrete and bituminous macadam and 10.1 mi. of gravel and bituminous macadam, the balance being bituminous macadam. The reconstruction work includes 5.56 mi. of bituminous macadam, the balance being cement concrete. The foundations in nearly all cases, both in construction and reconstruction, are specified as gravel, though a few are classed as stone fill. The combined construction and reconstruction job is of bituminous macadam on a stone fill foundation.

The three bridges included in the list are in the Town of Becket, on the Bonny Rigg—North Becket Road, near the Becket railroad station.

TEXAS HIGHWAY DEPARTMENT DIVISION ENGINEERS

Because of the temporary lull in road building by reason of the lack of state aid and other funds, the Texas Highway Commission has reduced the number of divisions from nine to eight.

The divisions and the engineers in the state are as follows. Division 1, W. F. Hutson, 502 State Bank Bldg., Dallas; Division 2, Henry J. Cox, 502 State Bank Bldg., Dallas; Division 3, James E. Pirie, Box 357, Ballinger; Division 4, James G. Lott, Box 89, Amarillo; Division 5, D. E. H. Manigault, Court House, El Paso; Division 6, Chas. R. Haile, San Antonio; Division 7, Leo Ehlinger, Austin; Division 8, A. C. Love, Bryan.

The Advantages of a Topographical Map in City Planning

(Continued from page 245)

give each house a color to denote its use such as one-family residence, two-family residence, three or more family residence, business, industrial, and nuisance uses. Other sets of fundamental maps can be prepared easily, showing by color the heights of buildings, per cent. of area of lot covered by buildings and the assessed land values on a front foot basis.

Necessary Guides In Selecting Zones

Certain other studies preliminary and essential before drawing a tentative zone plan, can be made from the topographic map. The built-up areas are noticeable at a glance. The trend of growth out the main highways and the development between them is apparent. Parks and cemeteries, where people do not dwell and, therefore, where zoning for residence or business will not be necessary, show on the map. It will show by the contours and physical features, the lands suitable for future parking, along the streams, ravines, cliffs, etc., where the land is not so adaptable to building purposes. Low, flat lands along the water front and railroads, suitable for industrial sites, for railroad yards, warehouses, piers, docks and shipyards are readily determined. The topography directs attention to the areas suitable for residential development.

(Concluded on page 252)

MEETINGS

Calendar of Coming Meetings

Dec. 5-12—American Association of State Highway Officials.—Annual meeting, Omaha, Neb. Secretary, John H. Mullin, St. Paul, Minn.

Jan. 17-20, 1922.—American Road Builders' Association.—Nineteenth Annual Convention, Twelfth Americal Good Roads Congress and Thirteenth Good Roads Show under the auspices of the A. R. B. A., The Coliseum, Chicago, Ill. Secretary, E. L. Powers, 11 Waverly Place, New York, N. Y.

CONFERENCE OF GOVERNORS

The Thirteenth Annual Conference of Governors will be held at Charleston, S. C., on Monday, Tuesday and Wednesday, Dec. 5, 6 and 7.

ASSOCIATED PENNSYLVANIA HIGHWAY CONTRACTORS

The second annual meeting of the Associated Pennsylvania Highway Contractors will be held at the Penn-Harris Hotel, Harrisburg, Pa., on Dec. 15.

On the following day there will be a highway conference for contractors, engineers, material producers, machinery manufacturers and representatives of banks and surety companies. The morning session, from 10:00 a. m. to 1:00 p. m. will be devoted to a discussion of road building problems from the viewpoints of bankers, surety companies, engineers, cement producers, and coarse and fine aggregate producers. The afternoon session, from 2:30 to 5:00 p. m., will be given over to a consideration of the handling of road materials and other problems of especial interest to equipment manufacturers and to the members of the Pennsylvania State Highway Department.

It has been announced that talks will be limited to 15 minutes each and discussions to 5 minutes, and that papers will be presented in condensed form.

The meeting will conclude with a subscription dinner at 7:00 p. m.

AMERICAN ROAD BUILDERS' ASSOCIATION

Among the firms that secured reservations at the October drawing for space at the coming Thirteenth National Good Roads Show to be held in connection with the annual convention of the American Road Builders' Association at Chicago, Ill., Jan. 16-20, were the following:

Acme Road Machinery Co., Frankfort, N. Y.; American Casting Co., Birmingham, Ala.; “The American City,” New York, N. Y.; the Asphalt Association, New York, N. Y.; the Atterbury Motor Car Co., Buffalo, N. Y.; the Austin-Western Road Machinery Co., Chicago, Ill.; the Autocar Co., Ardmore, Pa.; Baldwin Chain & Mfg. Co., Worcester, Mass.; Barber Asphalt Paving Co., Philadelphia, Pa.; Barber-Greene Co., Aurora, Ill.; the Barrett Co., New York, N. Y.; the Beach Mfg. Co., Charlotte, Mich.; the Blaw-Knox Co., Pittsburgh, Pa.; the Brown Hoisting Machinery Co., Cleveland, Ohio; the Byers Machine Co., Ravenna, Ohio; the Cabell Petroleum Co., St. Louis, Mo.; the Philip Carey Co., Lockland, Cincinnati, Ohio; the Chain Belt Co., Milwaukee, Wis.; the Clark Tructractor Co., Buchanan, Mich.; the F. D. Cummer & Son Co., Cleveland, Ohio; the Domestic Engine & Pump Co., Shippensburg, Pa.; the Dunn Wire-Cut Lug Brick Co., Conneaut, Ohio; the Earth Concrete Co., Grand Rapids, Mich.; the East Iron & Machine Co., Lima, Ohio; the Electrical & Specialty Supply Co., Chicago, Ill.; “Engineering & Contracting,” Chicago, Ill.; the “Engineering News-Record,” New York, N. Y.; the Equipment Corporation of America, Chicago, Ill.; the Fate-Root-Heath Co., Plymouth, Ohio; the Four-Wheel Drive Auto Co., Clintonville, Wis.; the Galion Iron Works & Mfg. Co., Galion, Ohio; “Good Roads,” New York, N. Y.; L. P. Green, Chicago, Ill.; W. & L. E. Gurley, Troy, N. Y.; the Hadfield-Penfield Steel Co., Bucyrus, Ohio; the Heil Co., Milwaukee, Wis.; Hetherington & Berner, Indianapolis, Ind.; the Holt Mfg. Co., Peoria, Ill.; Hvass & Co., Inc., New York, N. Y.; the International Motor Co., New York, N. Y.; Jennings Automatic Dump Body, Inc., Roanoke, Va.; the J. T. Tractor Co., Cleveland, Ohio; the Keystone Driller Co., (Chicago office), Chicago, Ill.; the Kissel Motor Car Co., Hartford, Wis.; the Koehring Co., Milwaukee, Wis.; the Lakewood Engineering Co., Cleveland, Ohio; the Lee Trailer & Body Co., Chicago, Ill.; Le Roi Co., Milwaukee, Wis.; the Lewis Mfg. Co., Chicago, Ill.; Littleford Bros., Cincinnati, Ohio; the Locomotive Crane Co., Champaign, Ill.; the Maxon Co., Milwaukee, Wis.; the Milwaukee Locomotive Mfg. Co., Milwaukee, Wis.; Monarch Tractors, Inc., (New York office), New York, N. Y.; the National Paving Brick Manufacturers' Association, Cleveland, Ohio; the Northwest Engineering Co., Chicago, Ill.; the Novo Engine Co., (New York office), New York, N. Y.; the Osgood Co., Marion, Ohio; the Oshkosh Mfg. Co., Oshkosh, Wis.; the Parker Motor Truck Co., Milwaukee, Wis.; the Pawling & Harnishfeger Co., Milwaukee, Wis.; the Pioneer Asphalt Co., Lawrenceville, Ill.; the Portland Cement Association, Chicago, Ill.; “Public Works,” New York, N. Y.; the Ransome Concrete Machinery Co., Dunellen, N. J.; the

Reo Motor Car Co., Lansing, Mich.; the Republic Truck Sales Corp., Alma, Mich.; Sauerman Bros., Chicago, Ill.; the Schact Motor Truck Co., Cincinnati, Ohio; the Seibert-Milburn Co., Columbus, Ohio; the Standard Oil Co. (Indiana), Chicago, Ill.; Stroud & Co., Omaha, Neb.; the Texas Co., New York, N. Y.; the Thew Shovel Co., Lorain, Ohio; the Titan Truck Co., Milwaukee, Wis.; the Truscon Steel Co., Youngstown, Ohio; the Turbine Sewer Machine Co., Milwaukee, Wis.; the W. S. Tyler Co., Cleveland, Ohio; Warren Bros. Co., Boston, Mass.; the Waukesha Motor Co., Waukesha, Wis.; the Wehr Co., Milwaukee, Wis.; the White Co., Cleveland, Ohio; the Wiard Plow Co., Batavia, N. Y.; the Western Wheeled Scraper Co., Aurora, Ill.; the Wisconsin Motor Mfg. Co., Milwaukee, Wis.; the Wood Hydraulic Hoist & Body Co., Detroit, Mich.

PERSONAL MENTION

G. McCreath has been elected county highway commissioner of Holt County, Nebraska.

J. B. Bennett has been appointed county engineer of Pottawatomie County, Oklahoma.

Edward S. Nettleton, who has been serving as acting city engineer of New Haven, Conn., has been appointed city engineer.

Capt. Robert K. West has been appointed acting Chief Engineer of the Junta Central de Caminos (Central Highway Commission), Republic of Panama, succeeding J. W. Beardsley, who recently resigned.

The Advantages of a Topographical Map in City Planning

(Concluded from page 250)

They can be so designated on the proposed use district maps. Housing areas convenient to industrial districts, to insure ample and satisfied labor supply are necessary. They are chosen with great care and discrimination, with due consideration for the existing developments. The engineer can with understanding, with knowledge of the growth of the city, with information shown by contours, select major traffic streets which will probably become retail business streets or heavy commercial haulage ways. Parkways and boulevards for the highest class residential frontage may be well chosen. All of these aspects of a zone plan are at once before the engineer or city planner who has an accurate, comprehensive topographic map upon which to work.

Maps of Baltimore Ideal

In 1894 the Topographical Survey Commission of Baltimore began the preparation of a topographic map of that city on a scale of 200 ft. to 1 in., with contours at 5-ft. intervals. The map covered 30 sq. mi., the city's area at that time. The old part of the city prior to the annex of 1888 had been planned in 1819 without reference to topography. On the new map a plan was drawn and adopted for the development of the territory annexed in 1888. The city is now following that plan. In 1914 another map showing all the buildings in the city was made with the surveyed street plan as the frame work. In 1918 an additional 60 sq. mi. of territory was annexed. Now the topographic map of 1894 is being extended to embrace the new addition and should be complete by 1922. These maps will give ample information on which to extend the street plan, design sewer extensions and water mains and to draw a zone plan, which ought to be the very best obtainable since it will be based on a mass of data not usually available for zoning studies.

Cost and Compensations

Does the cost of making such a map pay? Well, if Baltimore's sewerage system cost $20,000,000, it is conservative to estimate that 1% of that amount or $200,000 would have been spent for surveys had not the map of 1894 been made. The map was paid for then by saving on one project. Thousands of dollars have been saved to property owners and taxpayers by reason of having a map available for the use of surveyors and engineers. By planning streets with reference to the contour of the ground the expenditure has been paid for many times over. City planning pays and the use of the term "city planning" ought to include the topographic map as the first step toward a comprehensive plan.

Tests of Impact on Pavements by the Bureau of Public Roads

(Continued from page 248)

But while the values shown were nearer those desired, there yet remained to be found the force when there was no copper cushion, i. e., the actual force of blow when the plunger hit the slab. For this information it was necessary to resort to the space-time curves. A study of available information on the magnitude of impact forces is, to say the least, confusing. There is considerable disagreement on such questions as the relation of maximum to average force produced during a blow as well as the connection between static and impact forces. It is true there are fundamental theoretical formulae for deriving the force of impact as well as energy-work relations for determining average resistance. But when the impact force values are obtained, what do they mean and how do they help us? It will be remembered that this investigation of impact force was carried on only for the purpose of determining equivalent static load in the absence of the cushioning effect of the copper cylinder.

(To be continued)

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CONSTRUCTION TRANSPORTATION MAINTENANCE

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Concrete Roads must be Reinforced

It is demonstrated beyond doubt that to make concrete roads proof against heavy motor traffic, weather and time a fabric of steel must be incorporated in the concrete.

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Fort Fisher Highway, New Hanover Co., N. C. Treated with "Tarvia-B" 1915-17-18-19-21 and "Tarvia-A" in 1916.

Above is Wrightsville Turnpike, New Hanover Co., N. C. Treated with "Tarvia-A" 1915, and with "Tarvia-B" 1917 and 1921.

Another view of Fort Fisher Highway

"The Best Investment The Board Ever Made"

Mr. Addison Hewlett, Chairman of the Board of Comissioners of New Hanover County, N. C., writes, under date of July 25, 1921:

"We have been using Tarvia for surface treating the macadam roads of New Hanover County for the past six years, and we find this treatment satisfactory in every respect.

"Before we started the use of Tarvia we had great difficulty in maintaining our roads, as they became very dusty in dry weather and washed away in wet weather, leaving our road surface full of holes and ruts. Since using Tarvia the surface of the road has been well protected in all kinds of weather, and today our roads have smooth, hard surfaces and our maintenance problem has been very easily solved. The Tarvia treatment is very inexpensive.

"It is unquestionably the best investment the Board of Commissioners has ever made and the Commissioners would not consider for a moment discontinuing Tarvia on our roads."

Tarvia
For Road Construction Repair and Maintenance

Additional comments on Tarvia are made by R. A. Burnett, County Superintendent of Roads:

"Tarvia treatments are given to some of our roads every year while other roads, such as the Wrightsville Turnpike, have lasted as long as three years before requiring another treatment.

"These treatments have cost us in the neighborhood of $300 per mile per year and have proved to be the best, easiest and cheapest method of maintaining our roads. We have always had the best of co-operation from your engineers . . . . .

"We feel that we have a finer system of roads than any other county in the State."

No matter what your road problem may be—new construction, maintenance, or repairs—there is a grade of Tarvia made especially for the purpose.

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GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

WITH WHICH IS INCORPORATED

THE HIGHWAY CONTRACTOR AND ROAD BUILDER

Vol. LXI., NEW YORK, N. Y., DECEMBER 7, 1921 No. 23

Ornamental Street Lighting*

By L. A. S. WOOD†

The lighting of streets is a vital municipal issue and adequate illumination, besides being a convenience, is a protective necessity to every community. Good lighting is an indication of prosperity, and an investment in a well designed ornamental street lighting system returns large dividends to the taxpayers in increased real estate values. Good street lighting creates an impression of thrift and progress, advancing civic pride, attracting favorable publicity, and promoting other improvements. It assists the fire and police departments, facilitates traffic, and decreases crime.

In the early days of electricity, street lighting design was a simple problem, the solution generally taking the form of suspended arc lamps at street intersections. But with the growth of the "city beautiful" idea, there came a demand for more ornamental lighting systems and the elimination of the unsightly overhead equipment. This introduced many new factors into the problem, the more important of which are: The size of the city, the character of the buildings, the presence of foliage on the streets, and the local conditions controlling the distribution of electricity.

The standard of illumination was set by the earlier

WELL-LIGHTED BUSINESS STREET IN NEWCASTLE, PA.—ILLUMINATION CHIEFLY DOWNWARD types of "open" carbon arc lamps which were replaced later by an improved type having more burning hours and designated as "enclosed" carbon arc lamps. These were not so efficient as the former and their use tended to decrease the standard of illumination. This standard was generally lower than that of the larger European cities.

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*Abstract of parts of a paper presented at the 27th annual convention of the American Society for Municipal Improvements, Baltimore, Md., Oct. 25-28, 1921.

†Manager, Illuminating Section, Westinghouse Electric & Manufacturing Co., George Cutter Works, South Bend, Ind.

Street lighting rates have remained practically constant for many years in spite of large increases in the cost of materials and labor. The per capita cost is over $3 in few cities, the average for the best lighted 50 cities being about $2 and that for the whole United States not over 75 ct.

ORNAMENTAL LIGHT STANDARD HARMONIZING WITH ITS SURROUNDINGS—MIAMI BEACH, FLA.

Since the introduction of the high efficiency "Mazda C" incandescent lamp, development in ornamental street lighting has favored the single light post equipped with a suitable lighting unit to distribute and direct the light on the plane of illumination.

The first requirement of an ornamental street lighting system is that, while efficiently illuminating the streets during the hours of darkness, it shall be inconspicuous during the day and shall blend harmoniously with the surroundings. This is well demonstrated by an ornamental lighting installation in Chicago, within two blocks of the busiest part of the Loop. Another important requirement is that the intensity of illumination be graduated in accordance with local conditions. The private installation of "white ways" should be discouraged and consideration given to street lighting installations as parts of coordinated plans for city beautification.

There are various methods of promoting the installation of ornamental lighting systems. The most successful have been those adopted by chambers of commerce or commercial clubs, municipalities, as a rule, being reluctant to consider such plans until there is a publicly expressed demand. In a number of states there are laws permitting the establishment of assessment districts for securing funds for the installation of special lighting. In such cases, 51% of the abutting property usually has to be signed up to make a petition effective. Lighting improvement acts have generally assisted the progress of ornamental lighting, and they should be taken advantage of where available. The assessment of property owners for the up-keep of lighting installations is not new, an account of the method followed in Paris, France, in 1666 occurring in "Municipal Government," by Frank J. Goodnow, published by the Century Company in 1910.

* * * * * * *

Until the introduction of steel armored and lead covered cable, it was customary to lay underground cables in conduits, but modern practice is to bury the steel armored cables in shallow trenches below the curb or in the parkway. In either of these positions it is not likely to be damaged. * * * *

In many of the larger cities there are exceptionally wide and important streets that require special treatment. In general, however, for the purpose of determining the correct lamp sizes, the best spacing and heights of mounting, streets may be divided into three classes: Important business streets, side streets, and residence streets. The following table gives approximate data, which, however, may be varied to meet local requirements.

Type of Street	Size of lamp in lumens*	Spacing, in feet.	Mounting height, in feet.
Important business	6,000-15,000	50-75	12.5-15
Side	2,500- 4,000	75-100	11.5-13.5
Residence	1,000- 2,500	150-250	10.6

On important business streets and on side streets the ornamental posts should be set symmetrically opposite each other on either side of the street, while on residence streets the posts should be staggered. On exceptionally wide and important streets a greater intensity of illumination is required and for that purpose two-light ornamental posts for use with 15,000 and 25,000 lumen lamps have been developed.

On streets where there are trolley poles, the best method of lighting is by the use of ornamental trolley brackets, with suitable lighting units, either with single or double arms. These present a very attractive

---

*The series Mazda lamp is now rated in lumens instead of in candle power, a lumen being equivalent to 10 c. p.

(Concluded on page 260.)

Tests of Impact on Pavements by the Bureau of Public Roads—IV*

Space-Time Curves Turned to Practical Use—Method of Deriving Impact Forces Changed—Maximum Force from Maximum Acceleration

By C. A. HOGENTOGLER†

(Continued from November 30)

Space-Time Curves Turned to Practical Use

The point to be stressed is that in the investigation of the space-time curves a means of turning these curves to practical use is being developed. The actual value of the maximum, or the average, or of any other impact force, is of little or no moment. What is desired is a knowledge of the effect produced by these forces. In other words, we would like to compare the effects produced by given impact forces with those produced by static loads. To do this, the impact force must be obtained from the space-time curves by means of theoretical computations, and then a relation must be found between the force and the equivalent static load. For obtaining usable impact values from the curves the following general relations were tried:

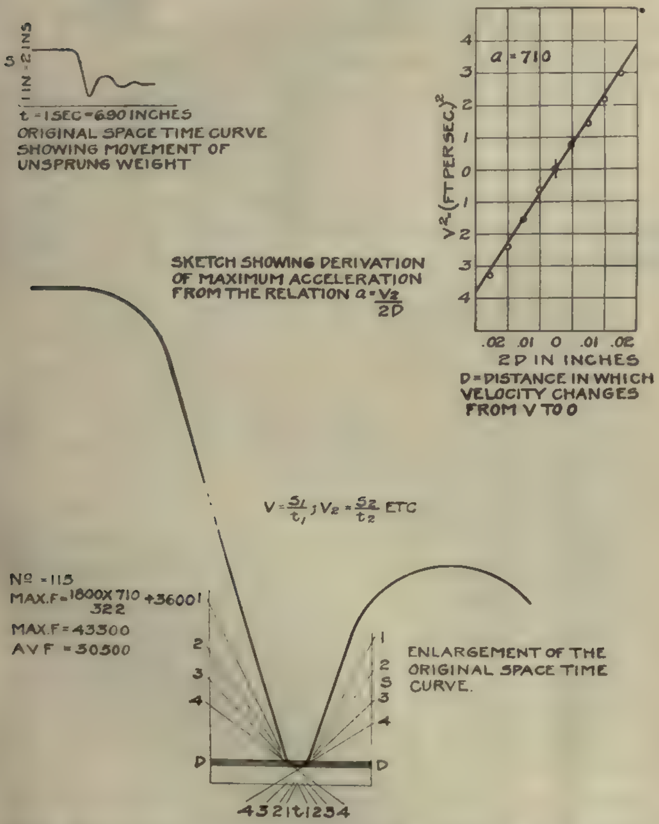

FIG. 6.—DERIVATION OF THE MAXIMUM ACCELERATION FROM THE RELATION $a = \frac{V2}{2D}$

1. The maximum force produced by an impact blow is equal to the greatest acceleration times the mass of the moving body.
2. The average force of an impact blow is equal to the average acceleration during time or distance of contact times the mass of the moving body.
3. The average force of an impact blow is equal to the total energy of the blow divided by the distance through which this energy is expended.

The first attempt to secure the force of the impact exerted by a drop of the plunger was made with the autographic curves secured during the first calibration. Since all authorities seem to agree that the maximum force of the blow is exerted at or near the point of greatest deformation a position near the lowest point of the curve was selected for the solution. An enlarged typical space-time curve and the graphical solution used in this derivation are shown in Fig. 4.

The relation used was;

$$F = Ma.$$

In which,

F = Maximum force of blow.
a = Maximum acceleration.
M = Mass of unsprung weight.

To obtain a, the following formula was used:

$$a = \frac{V_1 - V_2}{t}$$

In which,

t = Time in seconds.
V_1 = Velocity before the point of maximum deformation.
V_2 = Velocity after the point of maximum deformation.

The procedure, as shown in Fig. 4, was first to draw a horizontal line through the curve near its lowest point. Tangents were then drawn to the curve at its intersection with the horizontal line. These tangents or first derivatives gave the values V_1 and V_2 while the time was given by the length of the horizontal line contained between the two sides of the curve. Because of defects in the autographic recording device the results from this set of computations were of value only in so far as they indicated that dependable results could be secured from curves of proper size with correlated accurate time records. While the actual results were not usable, it was strongly suggested that a definite relation existed between the force as computed and the equivalent static load as given by the copper cylinder.

---

*From "Public Roads," the official publication of the Bureau of Public Roads, U. S. Department of Agriculture.

†Highway Engineer, Bureau of Public Roads, U. S. Department of Agriculture.

For a further investigation of impact force, several defects were eliminated from the recording apparatus, and the impact machine was loaded with 3,050 lb. unsprung and no sprung weight, the plunger being in effect a freely falling body. The sprung weight was eliminated in this calibration in order that the velocity as obtained by the tangent method might be checked by the theoretical velocity of a freely falling body. The procedure in securing deformations of the copper cylinders was the same as that followed in the first calibration described above.

Methods of Deriving Impact Forces Changed

For deriving the impact forces from the curves the method used was somewhat different from that previously described and involved the assumption that the maximum velocity of a falling body which is being stopped by a cushion occurs when the body has penetrated the cushion to such a depth that the resistance of the cushion equals the weight of the body. Since an inspection of the rubber and copper curves, Fig. 2, shows that a resistance of 3,050 lb. occurs with a deformation of 0.225 in., it was assumed that the maximum velocity of the plunger occurs at a distance of 0.225 in. below the point of first contact and becomes 0 at the lowest tip of the curve. The average acceleration can be expressed in two ways:

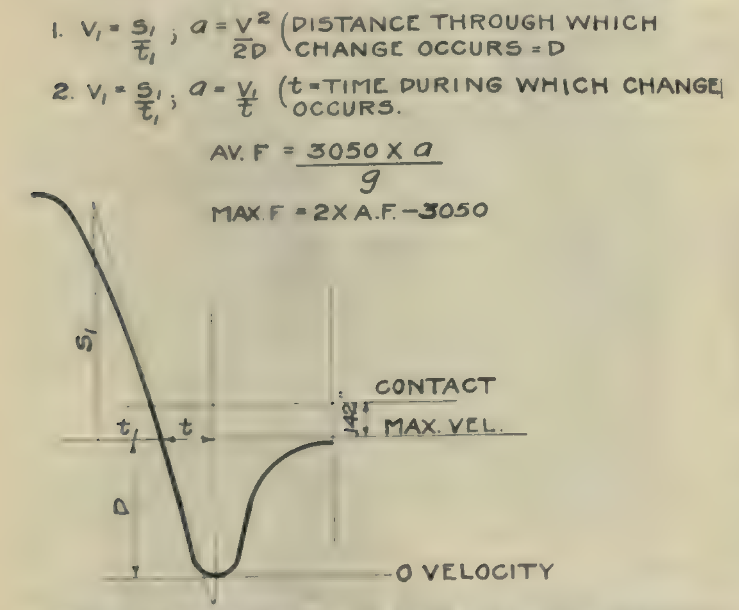
1. $V_1 = \frac{S_1}{t_1}$; $a = \frac{V^2}{2D}$ (DISTANCE THROUGH WHICH CHANGE OCCURS = D
2. $V_1 = \frac{S_1}{t_1}$; $a = \frac{V_1}{t}$ (t = TIME DURING WHICH CHANGE OCCURS.
AV. F = $\frac{3050 \times a}{g}$
MAX. F = 2 X A.F. −3050
S_1
t_1
t
D
CONTACT
.225
MAX. VEL.
0 VELOCITY

FIG. 6.—DERIVATION OF AVERAGE ACCELERATION BETWEEN POINTS OF MAXIMUM AND ZERO VELOCITY

1. Ave. $a=\frac{V}{t}$

V=Maximum velocity.

t=Time required to change from maximum to 0 velocity.

2. Ave. $a=\frac{V^2}{2D}$

V=Maximum velocity.

D=Distance from point of maximum velocity to lowest or point of zero velocity.

Fig. 5 shows how the values are taken from the curve. From the tangent is obtained the maximum velocity; the time, t, is the horizontal distance from the point of tangency to the lowest tip of the curve, while D is the vertical distance from the point of tangency to the lowest tip of the curve. Having determined the average acceleration from the curves the average force R, is obtained from the relation $R=Ma$. It is noted that R is the average force exerted from an initial force of 3,050 to a maximum to be determined.

The second assumpion is expressed by the relation

Max. $F=2R-I$

R=Average force

I=Force at point of maximum velocity (in these computations, 3,050 lb.).

TABLE 9.—COMPARISON BETWEEN EQUIVALENT STATIC LOAD AS INDICATED BY THE COPPER CYLINDER AND IMPACT FORCE AS COMPUTED FROM SPACE-TIME CURVES BY MEANS OF BOTH VELOCITY SQUARED-SPACE AND VELOCITY-TIME RELATIONS BETWEEN THE POINTS OF MAXIMUM AND ZERO VELOCITY.

No.	Copper cylinder static equivalent.	Approximate computed maximum velocity.	Maximum velocity as obtained from tangent to curve.	Velocity squared-space relation.		Velocity-time relation.	
				Ave. $a=\frac{V^2}{2D}$	F=2R−I.	Ave. $a=\frac{V}{t}$	F=2R−I.
1	22400	3.190	3.254	134.5	22450	143.8	24210
2	24400	3.440	3.700	148.7	25090	145.5	26510
3	26000	3.610	3.885	154.2	26150	183.4	31870
4	28600	4.080	4.150	167.1	28610	[illegible]	31510
5	30200	4.235	4.287	176.2	30310	178.5	[illegible]
6	21800	3.280	3.360	132.0	21950	151.3	25590
7	20000	3.080	3.140	123.5	20350	154.2	....
8	16500	2.530	2.700	105.0	16850	103.3	17610
9	15600	2.360	2.590	101.6	[illegible]	110.2	17810
10	11100	1.580	1.746	72.4	10670	72.9	10770
11	8600	1.360	1.343	58.6	8250	60.65	8845

Sprung weight=0. Unsprung weight=3,050 lb.

The comparison of the forces obtained by this series of drops is shown in Table 9. These results clearly indicate that the equivalent static load as given by the copper cylinder is about the same as the maximum force as computed from the curves by means of the above methods. It will be noted that the tangential velocities are slightly greater than the theoretical and also that the forces as computed from the velocity-time relation show more variation than those from the velocity-space relation. The reason for the latter condition unquestionably lies in the fact that more accurate measurements can be made on the curves for distance than for time.

Althought the results shown for this study of the curves were encouraging, the methods employed for securing the results seemed too cumbersome for practical use. These results, however, are again indicative of a definite relation between equivalent static load and impact force.

Maximum Force from Maximum Acceleration

There is being developed at present by the Bureau of Public Roads a device which when attached to a motor truck will give space-time curves showing the movements of the sprung and unsprung parts of the

(Continued on page 261.)

Road Building in Michigan*

Historical and Descriptive Sketch of the Application of the State Aid Principle to Michigan Work—Resume of Work Done and Under Contract—Present Status of Roads—Gravel and Macadam Construction

By FRANK F. ROGERS†

Michigan began aiding the counties and townships in the building of roads during the fiscal year beginning July 1, 1905. The aid rendered was very small, ranging rom $250 to $1,000 a mile for work done in accordance with the state specifications. In the early days there was a great deal of opposition to the work and progress was very slow, only 18 mi. of road being improved with state aid during the first year.

In 1908 or 1909 the automobile began to be a factor in rural transportation, but it was not until 1912 or 1913 that it became important enough to have to be considered in the design and construction of roads. From then on, however, automobiles increased so rapidly that the demands of automobilists became a greater factor than all others in the good roads movement.

The state trunk line act was introduced in the 1912 Legislature by Senator Wm. H. Allswede, and was passed. It established a state trunk line system of about 3,000 mi. of road, connecting nearly all of the important towns of the state. While it left the construction of roads in the hands of the town and county commissioners, it stimulated work on the trunk lines by doubling the rewards. In addition, the state commenced the construction of all trunk line bridges of more than 30 ft. clear span on condition that the township or county build 3 mi. of trunk line road, including the bridge.

This greatly stimulated trunk line work, but it remained for the 1919 Legislature to pass the present trunk line act which provides that the system established by the 1913 law shall be constructed and maintained "under the direction, supervision and control of the state highway commissioner." Up to the time of that legislation the townships and counties had improved approximately 40% of the trunk lines then established, but it was evident that the state would have to complete the work because certain townships and counties were unable to assume the burden and others were unwilling to do so.

To further stimulate the work, the Legislature provided for a constitutional amendment authorizing a $50,000,000 bond issue, and it was voted overwhelmingly at the election in April, 1919. Though the war had ended, prices had then reached the peak. Wages were high and the railroads, which had been taken over by the Government, were unable to carry the goods turned over to them. Because of these conditions, it was impossible to put on a very large road building program and the comparatively small mileage of roads that was built cost at least a third more than it would have cost a year or two previous and fully one-fourth more than at present.

The 1921 Legislature faced a very different economic condition. Factories and mines had slowed down or closed. Labor was idle, and both labor and commodity prices were declining. In order to meet the labor situation and take advantage of the declining market, it seemed wise to increase the road building program. Accordingly the fund available from the bond issue was increased from $5,000,000 a year to $10,000,000 a year and the interest limit was raised from 5% to 5.5% in order to float the bonds. However, it is impossible to float them at the increased interest rate and the state has had to resort to the selling of short-term 6% notes.

At present the state is receiving money for road construction and maintainance from three sources: Automobile taxes, state bond sales, and federal aid, the latter amounting to a little less than $8,000,000. The automobile money is used for paying the state's portion of maintenance, state reward on non-trunk line roads, the state's portion of the cost (50%) of non-trunk line bridges, and general departmental expenses. Bond money is used solely for building trunk line and federal aid roads and trunk line and federal aid bridges, although during the first two years it was necessary to use some of the money for paying state rewards on trunk line roads that were under construction by counties at the time of the passage of the bonding act.

Michigan began road building in cooperation with the townships and counties and still cooperates with them in both construction and maintenance. In fact, the present law requires the counties to pay from 5 to 25% of the cost of all trunk line and federal aid roads, the richer counties paying more than the poorer. Thirty-seven counties with a valuation greater than $500,000 per trunk line mile are required to pay 25%, while only two counties, with a valuation of less than $50,000 per trunk line mile, get off with 5%. The other counties pay varying amounts between 5 and 25%.

The original trunk line act provided for some 3,000 mi. of trunk lines. Subsequent legislation has increased this to upwards of 6,000 mi., which is about one-twelfth of the entire road mileage of the state.

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* Abstract of a paper presented at the annual meeting of the Michigan State Good Roads Association, Flint, Mich., Aug. 30-Sept. 1, 1921.

† State Highway Commissioner of Michigan.

Up to Jan. 1, 1921, the state had placed under construction, under the bonding, federal aid, and assessment district acts, 1,440 mi. of roads at a total cost of $21,647,455.28. Approximately 50% of this work had been completed on that date. On Aug. 15, 1921, the state had under construction 468 road and 41 bridge contracts. On the same date the state had 503 employees—an average of less than one to a contract, including clerks and stenographers.

Since Jan. 1, 1921, 460 mi. of road have been placed under construction at a total cost of $10,773.731.74, making a grand total of 1,900 mi. placed under contract at a total cost of $32,421,187.02 This is divided as follows: 1,079 mi. of regular trunk line contracts, amounting to $18,414,529.97; 416 mi. of federal aid contracts, amounting to $9,552,358.22; and 404 mi. of assessment district contracts, amounting to $4,454,298.93.

A notable feature of this year's work is the paving on trunk lines in cities and villages. The state trunk lines traverse 110 incorporated cities and 165 incorporated villages and for many years it has been noted that village and city streets on the main highways are frequently much poorer than the county roads coming up to their borders, especially those portions that happen to lie between a city or village pavement and the terminus of the improved road. The state is rapidly remedying this condition by placing such portions under construction. This year not less than 80 projects within incorporated cities and villages will be under construction and probably will be completed before the end of the road building season.

It is difficult for one not constantly driving over the roads of the state to realize what this mass of figures means, in terms of completed roads, to the road problem of Michigan. The trunk lines of the state have been numbered and on many of them mile posts have been erected. The East Michigan Pike, No. 10, forms one leg of the Dixie Highway. It has been completed—or is under construction with the expectation that it will be completed by fall—in all but two counties, Iosco and Cheboygan, and these pieces of road were left to the last because they are even now quite passable. On the West Michigan Pike, No. 11, another leg of the Dixie Highway, work is under way and will be completed by winter on all the gaps between the Indiana line and Mackinac City, except for short distances in Oceana, Antrim, Charlevoix and Emmett Counties. The Territorial Road is now under construction and it is expected that it will be open to travel by the end of the present road building season. No. 16 is now open to travel except for two short detours in Kent and Ottawa Counties. Trunk Lines 13, 14 and 18 are showing rapid progress and should be nearly completed by the end of 1923. Trunk Line 21 is nearly completed except for some 21 mi. in St. Clair County which are graded and will be surface with concrete by the close of 1922.

The foregoing illustrations are all from the lower peninsula, but important trunk lines in the upper peninsula, such as 12, 15 and 26, are also showing very marked progress. In fact, Trunk Line No. 12, over 400 mi. in length, is all open to travel, though some parts are under construction. This is the longest trunk line in Michigan and has been characterized as the best average piece of highway of its length to be found in any state this far west of New York.

Though it is not good taste to throw bouquets at one's self or even one's state, so many bad things have been said about Michigan's roads that it is quite refreshing to hear words of praise from people who have traveled widely in other states and are competent to judge. Only recently a Houghton lawyer said: "During last June, I traveled by automobile 3,750 mi., touring 13 states, and my judgment is that of all the state visited, Michigan's road stands second." He placed New York first.

Doubtless it is useless to give further illustrations, but it can be said truthfully that, barring unforeseen and unexpected economic conditions, all of the major trunk lines of Michigan will have been improved with good gravel, macadam, concrete, asphalt or brick by the time the $50,000,000 bond issue has been expended. There will still be left some minor trunk lines that will not have been improved at all and there will be many miles of the major trunk lines now surfaced with gravel and macadam that will be in sore need of rebuilding, and although they may not—and probably will not—be beyond the economic state of maintenance, they doubtless will have reached a state of such constant repair as to be annoying to public travel, while their surfaces will not be satisfactory to the average motorist.

We frequently hear of the state's great waste in building gravel and macadam roads, but the fact is that at the present time the most intensive maintenance on gravel and macadam roads—some of which now carry between 2,000 and 3,000 vehicles a day—is but little more than one-half of the interest charge on a modern paved highway. Under such conditions—and while the state is borrowing money at a high interest rate—men who are willing to buy roads, or see the state spend money on road improvement with the same degree of hard-headness that they exercise in their own business, will not criticize the building of cheaper types of roads in certain sections when those roads will serve the traffic adequately and will salvage later for more than one-fourth of their cost and furnish the best known foundations for pavements when the present road surface proves inadequate and the time comes for real paved roadways.

* * *

The State of Georgia has completed roads and bridges costing $9,367,486.01 during the fiscal year, according to figures given out by the Highway Department. In addition there is under way construction work amounting to $1,685,635.91.

GOOD ROADS
CONSTRUCTION TRANSPORTATION MAINTENANCE

Founded January, 1892

E. L. POWERS
Editor

T. A. HULBERT
Managing Editor

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Copy for advertisements must reach the New York office by noon on Tuesday of the week before date of issue if proofs are to be submitted.

Copy for classified and other advertisements where proofs are not required will be accepted until noon on Monday of the week of issue.

Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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Vol. LXI December 7, 1921 Number 23

WIDER ROADS OR FREIGHT AND PASSENGER ROADS?

On many heavily traveled trunk highways motor trucks seriously impede passenger traffic.

Comparatively few main roads are wide enough to accommodate safely four lines of traffic. On the others the presence of any considerable amount of truck traffic is sufficient to cause delays which, in the aggregate, constitute a very real loss of time. One truck lumbering along at a comparatively slow rate often holds back a long line of passenger cars. A single case of that kind amounts to little, but in a drive of fifty miles or so the total delay is often larger than is realized.

Sooner or later motorists are going to protest and motorists are numerous enough to be a factor that must be considered.

What is the remedy for the condition?

Both passenger and freight traffic must be taken care of; neither has rights greater than the other. Regulation or restriction may help, but neither can be a satisfactory solution. The alternative lies in design—either providing sufficient width for two lines of freight traffic and two lines of passenger traffic, or providing separate roadways for the two kinds of travel.

Economy would probably indicate the former in most cases, while safety would generally call for the latter. It is none too soon to take up the subject, for motor traffic is constantly and rapidly increasing.

The Motor Vehicle Death Toll The current year's death toll from automobiles and motor trucks on the highways of New York State will be just short of 2,000, according to a prediction based on the statistics collected by the National Highways Protective Society. Up to Nov. 30, the number killed was 1,741. The total for the entire year of 1920 was less than that by 312. The one encouraging fact is that it is safe to assume that only a very small proportion of these fatal accidents resulted from dangerous road conditions.

Present Trend of Motor Vehicle Legislation "A well defined trend toward higher license fees and more rigid weight restrictions" is seen, in the year's revision of motor vehicle legislation, by Congressman Charles C. Bond, counsel for the Motor Truck Association of America, in an article in "Highway Transportation," that organization's official publication. He also expresses the belief that: "Highway engineers, motor vehicle manufacturers and truck users are, today, in closer agreement on the essentials of motor vehicle legislation than ever before."

The Change in Traffic The change that has taken place in highway traffic—both in character and volume—is well illustrated by the results of traffic counts taken by the Nevada State Highway Department in 1917 and in 1921. Both counts were made on the same road and at the same time of year, but the road was unpaved when the first was made. When the 1917 census was taken the total number of horse-drawn vehicles recorded was 492 and the number of motor vehicles was 2,578. In 1921 there were only 188 horse-drawn vehicles, but there were 6,805 motor vehicles.

Mandatory Jail Sentences for Speeders Under an ordinance recently proposed for New York City, magistrates would have no alternative to imposing jail sentences upon convicted speeders. At present a fine is the usual punishment for excessively fast driving. While it probably will be necessary, eventually, to have recourse to more drastic action to check the evil of reckless motor vehicle operation, the remedy proposed for New York City is not a step in the right direction. The chief drawback to securing satisfactory results from such a regulation is that in the great majority of cases the word of the officer making the arrest is taken, regardless of the defense offered. Under these circumstances, the certainty of a jail sentence upon conviction would open up too great an opportunity for blackmail. Moreover, a measure like the one proposed ought not to be enacted without a general revision of the speed rules. A uniform limit for a city like New York, especially since it takes no cognizance of time of day or night, is manifestly absurd.

A RECENT NEVADA TRAFFIC CENSUS

Counts Taken by State Highway Department in 1917, 1920 and 1921 Show Great Decrease in Horse-Drawn Traffic and Great Increase in Motors

The Nevada State Highway Department recently took a traffic census on the Reno-Carson City Road at a point where two previous counts have been taken. The figures for 1921, compared with those of 1917, furnish an interesting example of the increase in motor traffic and the decrease in the use of horses for hauling.

When the first count was taken, in 1917, the road was unpaved. In 1920, when the second count was made, the highway had been paved from Reno to Browns and also on two short sections near Washoe City. When the last one was taken this fall, the road had been paved to the southern line of Washoe County at Lakeview. The count was made between 7 a. m. and 9 p. m. each day for a week. The results of the three counts are shown in the following table.

Type of Vehicle	Number of Vehicles		
Single-horse:	1917	1920	1921
Light	198	127	70
Heavy	23	22	17
Two- (or more) horse vehicles:			
Light	42	12	10
Heavy	229	136	91
Automobiles:			
Roadsters	364	791	1405
Touring cars	2029	3681	5093
Motor Trucks	142	319	220
Motorcycles	43	53	87
Total	3070	5141	6993

According to the "Nevada Highway News," from which the figures are taken; "While these counts do not show the maximum amount of traffic over this highway, which undoubtedly would occur some time during the summer months, they should, however, be representative of the average traffic throughout the year."

ORNAMENTAL STREET LIGHTING

(Concluded from page 254.)

appearance and prevent cluttering the streets with additional poles. Another method of using trolley poles is to encase them in ornamental cast iron shells with ornamental brackets attached.

Commercial ornamental posts may be divided into three classes: Cast iron, concrete, and pressed steel.

The earliest ornamental cast iron post, the history of which has been preserved, was erected in the Taj Mahal, Delhi, India, upwards of 1,600 years ago. It still stands—a monument to the durability of cast iron. Cast iron posts do not corrode or chip or crack under the influence of extremes of temperature. They withstand severe shocks, such as may be caused by ordinary street traffic, and they present the slender, graceful appearance so desirable in ornamental street lighting units.

Concrete is one of the most durable materials used in construction, but ornamental concrete posts must be of very heavy and substantial construction to withstand extremes of temperature. Unless made with the greatest care, they chip and crack in the northern climate.

The pressed steel post generally consists of a corrugated pressed steel shaft mounted on a cast iron foundation and surmounted by an iron capital, the whole being bolted together by three tie rods passing through the center of the shaft. This type presents a massive appearance, but the shaft is dented and bent by shocks that would leave a cast iron post unmarked.

* * * * * *

Lighting a street is not like lighting a room, in which the ceiling and walls reflect the undirected light, and for that reason provision should be made for directing the light emitted above the horizontal to the plane of illumination. With ornamental post lighting, however, it is desirable that a small amount of the light from the upper hemisphere be directed against the fronts of adjacent buildings and that glare be eliminated so far as possible. Glare within the range of vision of the pedestrian or the vehicle driver should always be avoided. The problem of designing lighting units of high intensity, but with a minimum of glare, has been solved by the introduction of the "Reflecto-Lux" post tops. They distribute a flood of light on the street, with a small amount directed upward to illuminate the front of buildings. The light emitted is sparkling and brilliant, the panels of ribbed glass assisting in diffusing the light and eliminating glare. The distribution is obtained by upper and lower parabolic reflectors which direct the light outwards. In addition, a portion of the light in the upper hemisphere is redirected by an opal glass band around the upper portion of the lamp or by a band of enamel on the lamp itself.

The Pennsylvania State Highway Department has announced that it has already received 25,000 applications for 1922 automobile registrations and that not more than five registrations will be issued to any person at one time. Shipment of the tags has already started and State Highway Commissioner Lewis Sadler urges motorists to make early application for registration so that they will have their tags for use by Jan. 1.

The South Dakota State Cement Commission expects to move its office from Pierre to Rapid City in the near future in order to be near the base of the state cement plant operations. This is the opinion of A. C. Hunt, of Rapid City, newly appointed member of the commission. It is planned to push the state plant to completion as early as possible. A. L. Wyman, a prominent attorney, of Yankton, has been appointed attorney for the commission.

MOTOR FATALITIES IN NEW YORK STATE

The number of persons killed by automobiles and motor trucks in New York State from Jan. 1 to Nov. 30, 1921, was 1,741, according to a report of traffic accidents prepared by the National Highways Protective Society.

The total killed during the entire year of 1920 was 1,429, or 312 less than the number in the 11 months of this year. It is predicted that the final count for the current year will be just short of 2,000.

The deaths during November were 225, of which 66 occurred in New York City.

NEARLY 50 MILES OF BRIDGES BUILT BY GOVERNMENT AID

Nearly 50 mi. of bridges, costing $20,235,200.13, have been built by federal aid in the four years and four months ending Nov. 1, according to a statement from the Department of Agriculture.

Of the total cost, the Government, through the Office of Public Roads, has contributed over $8,525,000. The work has been done in 35 states, those in which the largest amounts of work have been done being as follows: Georgia, $2,950,474.59; New Jersey, $5,108,402.75; North Dakota, $1,306,384.59; Oklahoma, $2,280,769.76; South Carolina, $1,404,278.25; and Texas, $809,967.20.

CORPUS CHRISTI CAUSEWAY OPENED TO TRAFFIC

The Corpus Christi Causeway, which replaces the former concrete causeway in Texas, destroyed by the floods of 1919, has been opened for traffic and will shorten the road into Corpus Christi many miles. The new roadway was completed by the cooperation of the State Highway Commission and the officials of Nueces County furnished $100,000 and the state the remainder.

Because of the importance of the causeway, as the connecting link in Trunk Road No. 12, the Highway Commission decided to furnish two-thirds of the cost with the provision that Nueces County would agree to construct the remaining portion of the highway through the county.

CAMPAIGN TO REDUCE GRADE CROSSING ACCIDENTS IN NORTH DAKOTA

Board of Railroad Commissioners to Undertake State-Wide Safety First Education

The National Safety Council has recently been advised that the Board of Railroad Commissioners of North Dakota is to undertake a state-wide campaign for the reduction of the number of grade crossing accidents.

As has been pointed out before, railroad men claim that 90% of the accidents at railway and highway intersections are due to the carelessness of the public; and, therefore, that the prevention of such accidents is beyond the powers of the railroad companies. It is also maintained by railroad officials that governmental agencies are in a better position than they are to conduct safety campaigns, because such a campaign by an individual corporation is often attributed by the public to selfish motives.

TESTS OF IMPACT ON PAVEMENTS BY THE BUREAU OF PUBLIC ROADS

(Continued from page 256.)

vehicle when passing over different types and conditions of pavements; and owing to the fact that the curves made by this apparatus can be solved by methods making use of the tip of the curve only, the next step in the development of force derivation involved the securing of the maximum force by means of the maximum acceleration. In the derivation of the maximum acceleration the velocity-distance rather than the velocity-time relation was used since previous study showed that space measurements were more accurate than the time. In the study of this method of force derivation the curves obtained during the investigation of the effect of copper cushion reduction were used. It will be noted that these curves represented drops on different sizes of copper cylinders

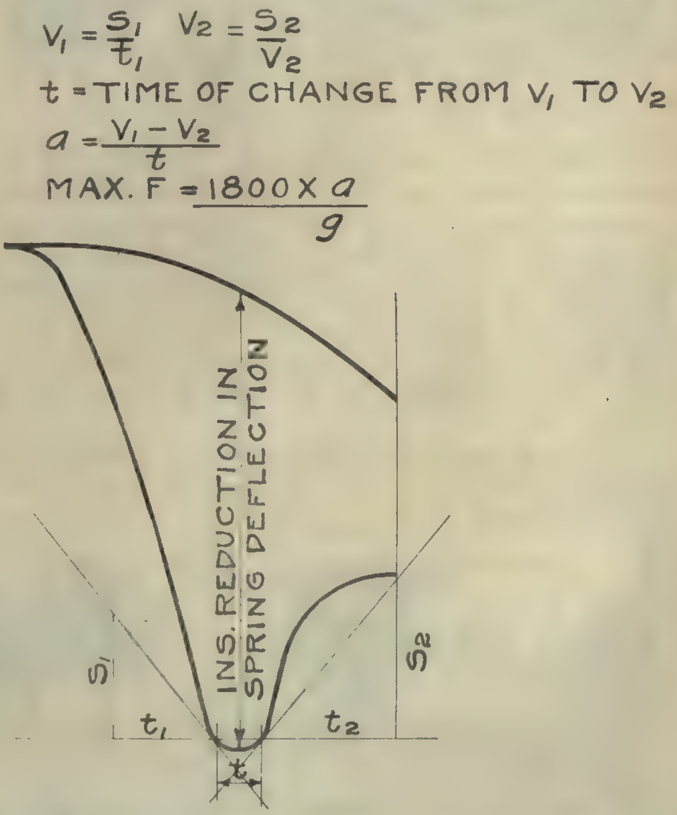
$V_1 = \frac{S_1}{t_1}$ $V_2 = \frac{S_2}{V_2}$
t = TIME OF CHANGE FROM V_1 TO V_2
$a = \frac{V_1 - V_2}{t}$
MAX. F = $\frac{1800 \times a}{g}$
INS. REDUCTION IN SPRING DEFLECTION
S_1
S_2
t_1
t_2
t

FIG. 4.—DERIVATION OF MAXIMUM ACCELERATION FROM SPACE-TIME CURVE, USING THE VELOCITY-TIME RELATION

(Continued on page 264.)

Equipment — Trade — Materials

NEW AUSTIN SUBGRADER

In the accompanying illustration is shown a new subgrading machine designed primarily to effect a saving of labor in finishing the roadbed after it has been rolled but before the depositing of concrete is commenced.

The subgrader is a one-man machine, operated by a gasoline engine and drawn along the forms by means of steel cables. The digging buckets are equipped with removable steel plow lips and are set to drive in five places to depths varying from 2 to 4 in. In trimming the road, two plows shave off the sides between the forms and the buckets. The buckets then trim the roadbed, depositing the excavated material on a 15-in. conveyor belt which discharges it outside of the forms. One passage over the subgrade is sufficient preparation for the laying of the concrete.

SIDE VIEW OF AUSTIN SUBGRADER

The machine is known as the Austin Subgrader and is manufactured by the Austin Machinery Corporation, of Chicago, Ill.

PORTLAND CEMENT PRODUCTION

Large Output in September—Shipments Made in Third Quarter of Year Established a Record—20% of Output Now Used in Roads

The movement of Portland cement continued on a large scale throughout September, according to the U. S. Geological Survey, more than 11,300,000 bbl. having been shipped from the mills. Shipments of Portland cement during the third quarter of the year were approximately 33,970,000 bbl., establishing a record for this quarter. For the nine months ending Sept. 30, 1921, the shipments amounted to 74,045,000 bbl., which exceeds the former record volume moved in the corresponding period of 1920.

Favorable operating conditions are indicated by the large September production of 10,027,000 bbl. of finished cement, which established a record for that month. The average daily production was greater than that of August, and had there been as many days in September as in August, the September production would have showed the larger total. Production for the third quarter likewise established a record, and for the nine months ending Sept. 30 the production was about 99.8% of the record quantity made during that period last year.

Stocks of cement at the mills were drawn upon to supply demand during September, as is customary in the season of active demand. At the end of the month stocks of finished cement at mills were approximately 6,953,000 bbl., compared with 8,280,000 bbl. at the beginning of the month. This is about 135,000 bbl. below the average for the month of September, 1917-1921.

The production of clinker, or unground cement, in September was approximately 9,329,000 bbl., which was a record for September and for the first nine months of 1921. Stocks of clinker at the mills amounted to about 3,200,000 bbl. at the end of September.

NEW AUSTIN SUBGRADER IN OPERATION

Wholesale prices of Portland cement per barrel, without bags, in carload lots, according to quotations published in trade papers, ranged as follows, the lower figures representing the quotations for the last week or two of September, 1921: At New York, $2.69 to $2.75; at Chicago, $1.97 to $2.17; at Minneapolis, $2.26 to $2.41; at Denver, $3.10; at San Francisco, $2.89 to $3.09; at Seattle, $3.10; at Atlanta, $2.69 to $2.75; at Dallas, $2.80; at Montreal, $3.10. These prices, except those at New York and Denver, which are considerably lower in 1921, are nearly the same as the prices quoted one year ago.

These statistics, prepared under the direction of Ernest F. Burchard, of the United States Geological Survey, and shown in the accompanying table, are based mainly on reports from Portland cement manufacturers and in part on estimated data. When considered in connection with the low demand for other commodities they show that the market for cement has been remarkable. A large quantity of cement, possibly 20% of the output, is now going into the construction of concrete roads; this is a large increase over former periods. The value of building permits issued during the last three months has shown an enormous total. A revival of building activity is well under way—probably to a greater extent than is generally realized. A great deal of the cement used in construction work is being consumed on small to moderate sized jobs, as few large engineering projects are under way and industrial buildings are at present being constructed on only a small scale.

PRODUCTION, SHIPMENTS AND STOCKS OF FINISHED PORTLAND CEMENT IN FIRST NINE MONTHS OF 1921

Month	Production (barrels)	Shipments (barrels)	Stocks at end of month (barrels)
January	4,098,000	2,539,000	10,300,000
February	4,379,000	3,331,000	11,400,000
March	6,763,000	6,221,000	12,000,000
First quarter	15,240,000	12,091,000	....
April	8,651,000	7,919,000	12,600,000
May	9,281,000	9,488,000	12,450,000
June	9,296,000	10,577,000	11,150,000
Second quarter	27,228,000	27,984,000	....
July	9,568,000	10,301,000	10,414,000
August	10,244,000	12,340,000	8,280,000
September	10,027,000	11,329,000	6,953,000
Third quarter	29,839,000	33,970,000	....
	72,307,000	74,045,000	....

The Bureau of Foreign and Domestic Commerce, Department of Commerce, reports that imports of hydraulic cement in August amounted to 10,988 bbl., valued at $32,315; the total for the first eight months of 1921 was 60,252 bbl., valued at $216,892. The exports of hydraulic cement in August were 84,538 bbl., valued at $295,183; the total exports for the eight-month period were 848,971 bbl., valued at $3,253,463. The exports are not keeping pace with those of 1920, in which there were nearly 3,000,000 bbl. exported during the year.

ASPHALT PRODUCTION STATISTICS

Asphalt sufficient to pave a surface of 78,000,000 sq. yd. or enough to roof 2,000,000 average sized American homes, was consumed in 1920 and the estimate for the present year shows an increase of 20%.

Few people are aware that asphalt is now largely manufactured from petroleum. Prior to 1902 the United States was dependent upon importations from Venezuela to supply its paving needs. No appreciable amount of asphalt was used in this country until 1883 when about 35,000 tons were imported mainly from the Island of Trinidad, Venezuela. In 1892 small importations were made from Bermudez, Venezuela, and from Cuba, but the supply being inadequate, producers turned elsewhere. By 1902 the product began to appear on the American market, 20,000 tons being used that year. Ten years later 500,000 tons of the petroleum product were being used annually in this country, 100,000 tons being manufactured from imported Mexican crude oil and 400,000 tons from domestic petroleum.

The quantity consumed annually increased steadily until last year in the United States, according to the Geological Survey, 198,497 tons of the native asphalt and native bitumens were used in addition to 700,496 tons of asphalt obtained from domestic petroleum. The value of the latter was $11,985,457, and showed an increase of 35% over the preceding year.

It is claimed that 45% of the asphalt used goes into paving and an equal amount into roofing and the remaining 10% into specialties.

"Making Seconds Count at the Loading Plant" is the title of a 4-page circular recently gotten out by the Koehring Company, of Milwaukee, Wis. The circular is devoted to an illustrated description of the company's portable aggregate bin and to a brief account of the use of the bin on a paving job in Wisconsin.

A new publication descriptive of excavating equipment has recently been issued by the Pawling & Harnischfeger Co., of Milwaukee, Wis. It is designated as Bulletin 56X and is a 28-page booklet, 8½x11 in. in size. It contains detailed descriptions of the excavating machinery manufactured by the company, together with many records of the actual performance of P. & H. excavators under widely varying conditions and on varied kinds of work. The bulletin is profusely illustrated and attractively printed.

"Texaco Sheet Asphalt" is the title of a new booklet issued by the Texas Co., Asphalt Sales Department, 17 Battery Place, New York, N. Y. It is 6x9 in. in size and consists of 16 pages, including covers. The contents comprise a complete but concise treatise on the construction of sheet asphalt pavements with "Texaco" materials. The text is illustrated by a number of cross-sections and by reproductions of photographs of finished pavements and pavements under construction. Copies of the booklet may be obtained by addressing the company.

The Blaw-Knox Co., Pittsburgh, Pa., will move its New York office from the City Investing Building to the Carbide & Carbon Building, 30 E. 42d St., on December 15.

MEETINGS

Calendar of Coming Meetings

Dec. 5-12—American Association of State Highway Officials.—Annual meeting, Omaha, Neb. Secretary, John H. Mullin, St. Paul, Minn.

Jan. 17-20, 1922—American Road Builders' Association.—Nineteenth Annual Convention, Twelfth Americal Good Roads Congress and Thirteenth Good Roads Show under the auspices of the A. R. B. A., The Coliseum, Chicago, Ill. Secretary, E. L. Powers, 11 Waverly Place, New York, N. Y.

HARTFORD CONFERENCE OF MOTOR VEHICLE AUTHORITIES

A conference of the motor vehicle authorities of the New England States and of New York, New Jersey and Pennsylvania will be held at Hartford, Conn., on Jan. 13 and 14, at the invitation of Motor Vehicle Commissioner Stoeckel of Connecticut.

Among the matters to be considered at the meeting is the formulation of a uniform operator's license law for presentation to the legislatures of the several states represented at the conference. Uniform legislation covering the operation of motor trucks will also be discussed.

THIRTEENTH NATIONAL GOOD ROADS SHOW

All of the initial 40,000 sq. ft. of space for the forthcoming Thirteenth National Good Roads Show to be held at the Coliseum, Chicago, Ill., under the auspices of the American Road Builders' Association, Jan. 16-20, having been reserved by 86 exhibitors at the first drawing in October, the officials in charge have arranged for about 20,000 sq. ft. of additional space to take care of a waiting list of about 50 firms not yet accommodated. Arrangements have been made by E. L. Powers, Secretary, for about 12,000 sq. ft. of space in the balcony of the Coliseum and 8,000 to 10,000 sq. ft. in two buildings adjoining the Coliseum Annex on the south.

Diagrams showing the new space were sent to prospective exhibitors recently. There were 144 exhibitors at the show last year and the indications are that this year the number will be nearer 200.

At a recent meeting of the directors of the A. R. B. A. it was decided to open the show with a band concert on the night of Jan. 16. The convention will open on the following day.

The new directors, elected at the annual meeting on Nov. 15, have chosen the executive committee as follows: President H. L. Bolby, Secretary E. L. Powers, Treasurer James H. MacDonald, H. E. Breed, and R. A. Meeker.

PERSONAL MENTION

Robert L. E. Ward has been appointed city engineer of Canon City, Colo.

J. P. Wehrung has been appointed district engineer for Falls County Road District No. 5, with headquarters at Chilton, Tex.

C. V. Conner, formerly an engineer with the State Highway Department of Delaware, has been appointed an assistant engineer with the North Carolina State Highway Department and assigned to work on the design and field inspection of bridges and hard surfaced pavements.

TESTS OF IMPACT ON PAVEMENTS BY THE BUREAU OF ROADS

(Continued from page 261.)

as well as drops in which no cylinders were used. The maximum acceleration was computed from these curves and with this acceleration a maximum force was obtained from the formula:

$$\text{Max. } F = \frac{1{,}800 X a}{32.2} \text{ (lb.)}$$

In which,

1,800=Unsprung weight (lb.)
a=Acceleration (feet per second per second.)

The procedure was as follows: Each curve was enlarged ten times by means of a precise pantograph. (See Fig. 6.) Four horizontal lines were then drawn through the bottom part of the space-time curve, these lines representing distances of one two hundredths, one one hundred and fiftieth, one one-hundredth, and one-fiftieth of an inch from the lowest point or point of zero velocity. Tangents to the curve for obtaining the velocities were drawn at the intersections of these horizontal lines. These velocities were squared and plotted as shown in Fig. 6, in which the vertical distances are the squares of the velocities and the horizontal distances are the above noted distances from the point of zero velocity. Through these points as plotted a line is drawn which is the slope of the $\frac{V^2}{2D}$ curve. The slope of this line equals a, the acceleration.

(To be continued)

GOOD ROADS

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Vol. LXI., NEW YORK, N. Y., DECEMBER 14, 1921 Number 24.

Recommendations for Increased Road Building by Conference on Unemployment

Committees on Emergency Measures in Transportation and on Permanent Public Works, as Well as Sub-Committee on Public Roads, Urge Enlarged Construction Program

Greater activity in road building was very generally recognized as a powerful agent for the relief of unemployment by various committees and individuals at the President's Conference on Unemployment held recently at Washington.

One of the committee reports in which greater road building and other public works programs are recommended is that of the Committee on Emergency Measures in Transportation. According to the official announcement, this report was "presented by part members of the subcommittee" and is "not the recommendation of the conference."

The report deals primarily with the unemployment situation on the railroads and most of it has little, if any, reference to road work. It points out, however, that much of the unemployment among railroad workers is due to the general business depression and that, insofar as this is a cause, the situation can be remedied only "to such an extent and with such promptness as there is a revival in business either in certain lines or in all lines." In reference to the effect of road building the report says:

"Increases in activity in road building and other forms of public construction work by the nation, states and municipalities will increase the demand for railroad transportation and to that extent decrease unemployment in railroad service, and we assume that the ways and means to bring about the stimulation of this public construction work will be discussed in the reports of the special committees dealing with these topics."

The report of the Committee on Permanent Public Works and the report of the Sub-Committee on Public Roads are printed in full in the following paragraphs. It should be noted that the latter, like the report of the Committee on Emergency Measures in Transportation, is "Presented by part members of sub-committee. Not the recommendation of the Conference."

Report of the Committee on Permanent Public Works

When public works are done in greater volume during periods of active industry, the same men and material are being competed for by both public and private employers. The inevitable result is to raise the height of the crest of the wave of cyclical business inflation and to cause a greater crash when the heightened wave breaks, as it always does.

In a growing country like the United States the aggregate volume of public works of cities, counties, states, and of the Federal Government is so great that if a larger proportion were executed in years of depression than in years of active industry, a powerful stabilizing influence would be exerted. In the past, however, public works officials have felt poor when business was depressed around them and, conversely, have often executed their chief undertakings when the contagious enthusiasm of captains of industry and of the general public has hailed a period of prosperity at hand. This tendency, although a natural one for an individual, does not accord with true economy for the city or with a sound national policy.

A large percentage of all public work is done out of the proceeds of bond issues to be paid off out of annual taxes received during subsequent decades. The credit of a well-managed city or state, as evidenced by the interest rate on long-time bonds, is less affected by a business depression than the credit of private corporations. Indeed, the supply of loanable credit for investment in municipal bonds is often greatest when industrial and railroad corporations are unable to obtain credit at maximum rates. This tendency, although accentuated by the present income tax exemption on municipal bonds, was true before the income tax was created. Not only can municipalities borrow more favorably than private borrowers in bad times, but by timing their public work during periods of inactive business and relative unemployment they can also secure a more plentiful and regular supply of materials and labor as an important economy in construction. When in addition to these already cogent reasons it is remembered that municipalities and their constituent citizens do in fact assume and bear the cost of destitution within their gates, any measure which tends to steady employment of their citizens in bad times and good will be sound policy from whatever point of view considered.

The leadership of the Federal Government in expanding its public works during periods of depression and contracting execution in periods of active industry requires no great change from existing procedure. Already the executing agency enjoys great latitude as to the period in which the appropriations may be spent. The remaining step is to choose the period of intensive execution to synchronize with major periods of industrial depression.

Certain works of the Federal Government such as reclamation, flood prevention, river and harbor work roads and public buildings, are peculiarly suited for consideration as large undertakings covering a long peroid and capable of elasticity of execution to synchronize with cycles of business depression.

The machinery legislated by the States of Pennsylvania and California to plan in advance for the expansion of public works during periods of depression is an example of present tendencies. Available estimates show that if 20% of ordinary necessary public works were deferred each year and the accumulation executed in a year of depression occurring once in ten years, the lifting power of public works would be at least one-third the dead weight of such a depression as the present. That the indirect effect would be even greater is indicated.

Recommendations

(1) That the Chairman of the Conference be requested to consider the advisability of appointing a committee to study methods and make recommendations for utilizing a percentage of the ordinary necessary public works of the Federal, state and city governments as a reserve against future periods of unemployment and industrial depression.

(2) That the studies of this committee should include the relation of the cities and states to any federal policy which may be suggested, and be published as part of the proceedings of the Unemployment Conference.

Report of the Sub-Committee on Public Roads

Many thousands of men now idle in this country can be promptly put to work if Congress and the states will push the program of road building on which they have spent over $452,000,000 in the past five years and for which they now have plans complete and large sums available.

In July of 1916, Congress appropriated $75,000,000 to be distributed among the states for road building. Each state was to receive its share when it had set up a satisfactory highway department and matched the federal grant dollar for dollar.

The offer was immediately seized upon. In 18 months 1,116 mi. of road had been placed under contract at a cost of about $19,500,000. Of this sum over $11,000,000 came from the states; that is, they had much more than met their federal grant.

Realizing that the disbanding of the army and possible business depression might result in a period of serious unemployment, Congress in 1919 appropriated $200,000,000 for road work. This was to be distributed on the same terms as the previous grant. The states responded promptly and generously. In the year 1920 they placed under contract 13,160 mi. of roads, costing about $212,500,000, of which less than $100,000,000 came from the federal treasury. Unfortunately for the workers of the country this splendid activity has not been kept up in the present year with anything like the vigor shown in 1920. Only 5,018 mi. of road were put under contract in the first eight months of 1921.

What are the causes of this slump at the moment when unemployment—the main reason for attempting the big program—is greater than could have been anticipated in 1919? Where are we to fix responsibility?

It lies first in Congress, where appropriations originate, and second in the states which are cooperating in the program.

The road building program of each state was based on the belief that the Federal Government would continue its support. All political parties were committed to this policy. The public was back of it. It was known, both by Congress and the states, that the $275,000,000 granted in the last five years would all be taken up before the end of this year and that more money must be appropriated in the present session, and as early as possible in the session, if the states were to know how much work they could plan for the present winter and the coming spring. Although various bills providing the expected federal aid for road building have been before Congress since early in the session and although unemployment has been more and more menacing, no action has as yet been taken. (Since this report was made Congress has passed a new law and made a new appropriation.—Ed.)

The delay is working infinite mischief throughout the country, actually threatening to make the unemployment crisis worse instead of relieving it. In many states where road building has been regarded as a matter of first importance and where appropriations based on federal aid have far outstripped the 50% requirements of the bill, work will be suspended unless Congress acts.

Take Minnesota as an illustration. It is spending on its highways this year approximately $23,500,000 of its own funds. Its program is based on the expectation that it would receive its quota of a new federal appro-

(Concluded on page 272)

Tests of Impact on Pavements by the Bureau of Public Roads—V [*]

Effect of the Maximum Force Determined—Energy-Work Relation Gives Simplest Curve Solution—Result of the Formulae Compared

By C. A. HOGENTOGLER[†]

(Continued from December 7)

Effect of the Maximum Force Determined

Having found a maximum force, the next step is to determine just what this force means. In other words, what is the actual effect produced by a maximum impact of a given magnitude?

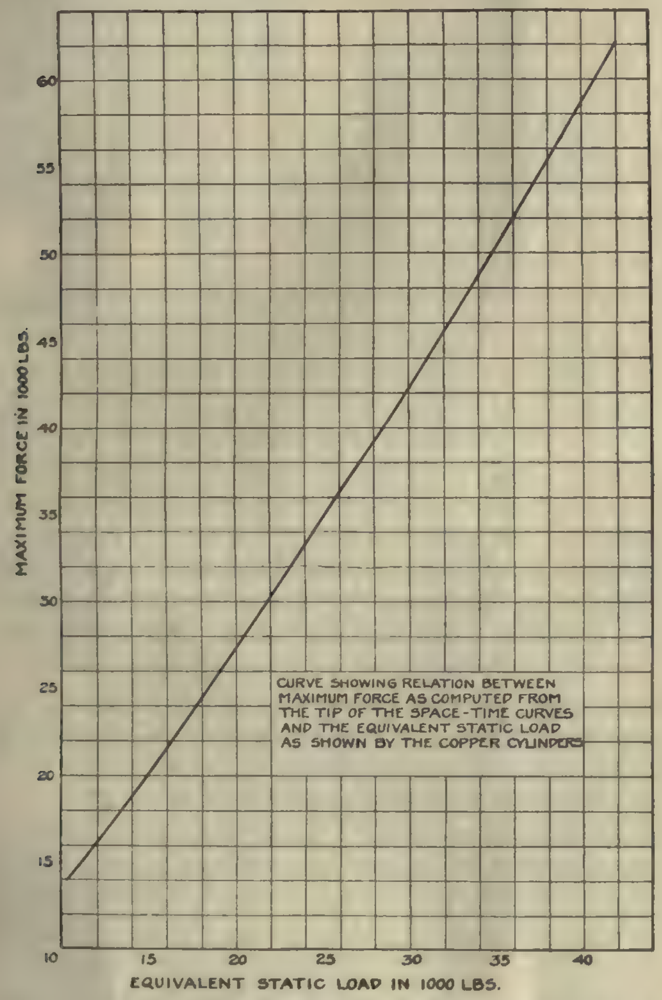

FIG. 7.—RELATION BETWEEN MAXIMUM FORCE AS COMPUTED FROM THE TIP OF THE SPACE-TIME CURVES AND THE EQUIVALENT STATIC LOAD AS SHOWN BY THE COPPER CYLINDER.

A means of determining this effect is afforded by the copper cylinders. By comparing the maximum impact forces as computed from the space-time curves with the static loads which cause equal deformations of copper a definite relation is found between the two, which is shown in Fig. 7. From this curve it will be seen that a maximum force causes the same deformation as would be occasioned by a static load of approximately two-thirds the magnitude. Having determined this relation an equivalent static load can be found for any maximum impact force, and knowing the maximum impact

TABLE 10.—COMPARISON OF EQUIVALENT STATIC LOAD AS OBTAINED FROM COPPER CYLINDER DEFORMATIONS WITH MAXIMUM FORCE AS COMPUTED FROM SPACE-TIME CURVES.

$$M=\frac{1800\times a}{32.2}$$

No.	Maximum acceleration (a).	Maximum force.	Equivalent static load by copper cylinder.	Free fall (H. F.)	Remarks.
		Pounds.	*Pounds.*	*Inches.*	
26	297	16,600	12,500	0.25	½ by ½ cylinder.
25	313	17,500	13,200	.34	¾ by ¾ cylinder.
51	423	23,600	16,600	.40	¾ by ½ cylinder.
4	555	30,740	21,700	1.08	½ by ½ cylinder, 1st blow.
4	582	32,600	23,700	1.07	½ by ½ cylinder, 2d blow.
4	625	34,950	25,300	1.04	½ by ½ cylinder, 3d blow.
62	833	46,700	32,600	1.74	¾ by ½ cylinder.
55	[illegible]	31,000	22,000	.63	1 by ½ cylinder.
5	750	42,000	[1] 29,800	1.12	No cylinder.
103	608	34,000	[1] 24,500	.72	Do.
108	1,019	57,000	[1] 39,100	2.91	Do.
101	967	54,100	[1] 37,400	2.28	Do.
110	722	40,350	[1] 28,700	1.06	Do.
115	705	39,400	[1] 28,100	1.08	No cylinder; Time doubtful.
100	324	19,000	[1] 14,100	.24	No cylinder.
112	857	47,900	[1] 33,500	1.80	Do.
107	1,052	58,800	[1] 40,100	3.04	Do.
26	414	23,150	[1] 17,100	.28	Do.

[1] EQUIVALENT STATIC LOAD COMPUTED.

TABLE 11.—INVESTIGATION OF EFFECT OF REDUCTION OF COPPER CUSHION ON FORCE PRODUCED BY SAME HEIGHT OF FALL.

Percentage of increase of force produced when using rubber alone against that of rubber and ½ by ½ inch copper cylinders.

Free fall (H. F.)	Equivalent static load as shown by copper cylinders.					No. cyl.	Per cent Increase.
	½ by ½	¾ by ¾	¾ by ½	1 by ½	1½ by ½		
Inches.							
0.25	12,500 0.143	18,000 0.070	18,800 0.045	14,500 0.016	15,000 0.007	15,100	20.7
.50	16,600 .202	17,600 .114	19,300 .078	20,200 .030	21,600 .014	21,700	30.7
.75	19,200 .230	[illegible] .140	22,000 .097	23,400 .038	25,700 .019	25,700	33.8
1.00	21,200 .250	22,200 .160	23,800 .109	25,600 .045	28,400 .023	28,400	33.9
1.25	22,900 .265	23,800 .178	25,200 .118	27,100 .050	30,200 .025	30,300	32.3
1.50	24,300 .271	25,200 .193	26,400 .127	28,300 .054	31,500 .027	32,100	32.8
1.75	25,500 .278	26,300 .204	27,300 .133	[illegible] .058	32,800 .028	33,500	31.3
2.00	26,400 .283	27,200 .213	28,100 .137	30,100 .060	33,300 .030	34,900	32.3
2.25	27,100 .286	28,000 .222	28,900 .144	30,700 .062	33,900 .030	36,200	33.5
2.50	28,000 .291	28,700 .228	29,500 .148	31,300 .064	34,300 .031	37,400	33.6
2.75	28,600 .293	29,400 .236	30,200 .152	31,800 .065	34,700 .031	38,500	34.7
3.00	29,800 .296	30,000 .342	30,900 1.56	32,400 .067	34,900 .032	39,700	35.5

Note.—Light face figures under equivalent static loads show copper cylinder deformation or cushion in inches for the particular blow.

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[*] From "Public Roads," the official publication of the Bureau of Public Roads, U. S. Department of Agriculture, October, 1921.

[†] Highway Engineer, Bureau of Public Roads, U. S. Department of Agriculture.

force when no cylinder is used, it is a simple matter to find the corresponding equivalent static load.

The values shown in Tables 10 and 11 were obtained by first computing the maximum force and finding the corresponding equivalent static load from the curve. As noted before, it has been known that as the depth of cushion is decreased the impact increases. This effect or increase is shown very clearly in Table 11 and Fig. 3. (Printed in a previous installment.—Ed.) It will be noted that in obtaining these results copper cylinders of the following sizes are used:

½ in. diameter by ½ in. long..........1 blow.
½ in. diameter by ½ in. long..........2 blows.
½ in. diameter by ½ in. long..........3 blows.
¾ in. diameter by ¾ in. long..........1 blow.
¾ in. diameter by ½ in. long..........1 blow.
1 in. diameter by ½ in. long..........1 blow.
1¼ in. diameter by ½ in. long.......1 blow.

This represents a sample of every kind of copper cylinder used at Arlington as well as the second and third blows on the same cylinder. It will be noted from these tables that the equivalent static load as shown by deformation of the copper cylinders agrees with two-thirds of the maximum force as obtained from the space-time curves by the above computation within about 5%. This would seem to indicate that there is a definite relation between equivalent static load and force produced by impact blows.

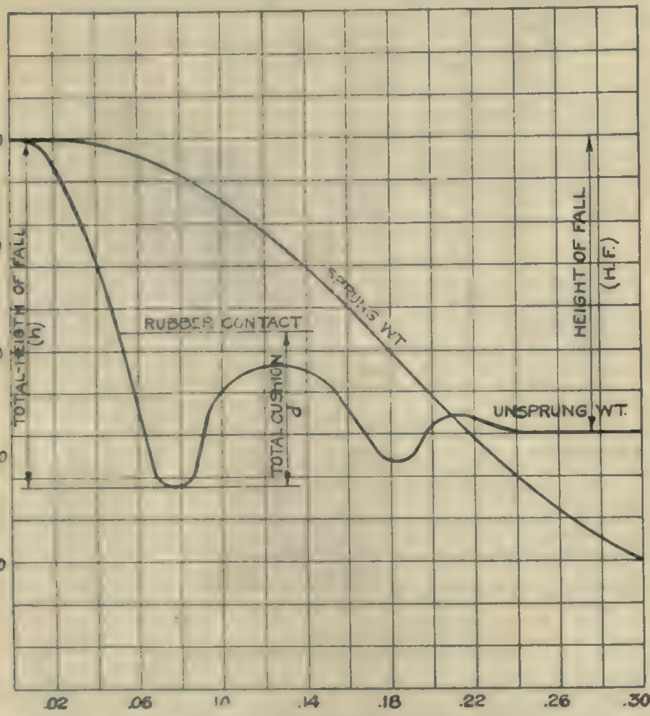

FIG. 8.—SPACE-TIME CURVE, SHOWING ENERGY-WORK RELATION

It must be remembered that this investigation of the impact blow was carried on only for the purpose of determining the equivalent static load in the absence of the cushioning effect of the copper cylinder. The close agreement of the above results has been accepted as justification of the use of the no-cylinder curve to represent the values with the effect of copper cushion eliminated. It must be pointed out, however, that these conclusions and the results are neither final nor absolute. They are accepted only because nothing better has been offered. There are several possible sources of error in the curve computations. First, the time can not be considered as accurate. Autographically, the time intervals are recorded only in seconds, while the computations deal with hundredths of seconds and even smaller intervals. The average time as shown on the graphs in which one second is represented by from 6 to 9 in. horizontally might not be exact for the interval of contact. Again, it is impossible to enlarge the small curves with the degree of accuracy necessary for exact solution of velocities. The slightest variation in the enlargement means a large error in the computed velocity. This explanation and the details of the procedure used are given so that the results can be taken for what they are worth.

What can be said then from the above results is that the maximum force at the tip of the curve computed by the mass-acceleration method, as shown, produces the same effect upon a copper cylinder as a static load of approximately two-thirds the magnitude. Knowing this, then these curves become valuable for measurement of force.

Energy-Work Relation Gives Simplest Curve Solution

By far the simplest solution of the curves secured during the slab tests is that making use of the energy-work relation. When the plunger of the impact machine or the wheel of a motor truck falls through any distance, a certain amount of energy is developed by the mass acted upon by gravity as well as the spring pressure. This energy must be used up before the wheel can be brought to a stop. In other words, the total energy must be balanced by the resistance of the rubber tire, copper cylinder, slab, etc., acting through the distance of total deformation. Referring to the enlarged space-time curve (Fig. 8) showing the movement of the unsprung weight it is noted that the total energy of the blow is equal to total drop (h) times the weight of the plunger plus the average spring pressure exerted on the plunger falling through the distance (h). This energy is expended on an average resistance acting through the distance (d). The average resistance is obtained from

$$R = \frac{(W + f)\,h}{d}$$

In which,

R = Average resistance.
W = 1,800 = Weight of plunger.
f = Average spring pressure acting through distance (h) which value is obtained from Fig. 10.
d = Total depth of deformation.
h = Total height of fall.

In this case as in the preceding one the average resistance is of value only when its effect can be expressed in static terms. An examination of the results indicated that the equivalent static effect on the copper cylinder was expressed by the relation

Equivalent static load = $2R—P$

P becomes zero when the height of fall (*h*) is greater than the cushion (*d*). When $h = d$ (in small drops with rubber in contact with slab) the value for *P* is taken from the rubber deformation curve and is equal to the static load necessary to deform the rubber the amount it is deformed at the beginning of a particular blow.

Results of the Formulae Compared

Tables 7, 8 and 12 show the equivalent static load as given by the copper cylinder and the maximum force as obtained from the above formulae. The comparisons afforded by these tables are exceedingly interesting. It will be noted that the tables show results obtained with the machine loaded in three different ways. Table 7 shows results obtained with a sprung weight of 6,000 lb., and an unsprung weight of 2,000 lb. In Table 8 the sprung weight is 6,000 lb. and the unsprung weight 1,800 lb. In Table 12 are shown results when only a freely falling unsprung weight of 3,050 lb. was used. In this table a very close agreement of results can be noted, the average variation being 2.5%. Also it can be seen that in this table the variations are such as might be expected in a series of observations, that is, that the variations are the same for high drops as for low drops. This would warrant the conclusion that the relation expressed above holds good for any amount of copper deformation.

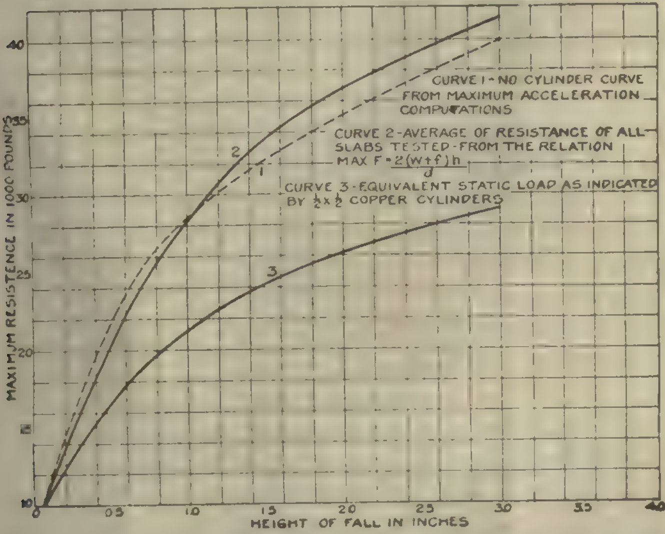

FIG. 9.—CURVES SHOWING THE RELATION OF COMPUTED VALUES OF STATIC EQUIVALENT LOADS AND THE STATIC EQUIVALENTS AS MEASURED BY COPPER CYLINDERS.

Table 7 shows that for low drops there is an average variation of 4.5% and for drops between 1 and 3 in. the variations increase from 10 to 27 with an average of 20.5%. This increase in variation can be accounted for by the fact that as the height of fall increased the falling weights were interfered with by the guides and the beam which lifted the plunger. This interference would naturally reduce the total energy of the blow and consequently the theoretical force would be larger than that indicated by the copper cylinder. No slabs were tested with the machine loaded in either of the above described ways. For the actual tests the unsprung weight was 1,800 lb. and the sprung weight was 6,000 lb. The results obtained with this loading are shown in Table 8.

From the foregoing results it is apparent that a definite relation exists between the force of impact as computed from the space-time curves and the equivalent static load as indicated by the copper cylinder. It will be noted also that while the impact force, computed by the several methods has different values, a definite relation is shown between each value and the copper cylinder values, thus making the curves of practical use as a means of measurement of force. The indications are that the average force of impact as derived from the curves is one-third the maximum as derived from the tip of the curve, and the static load which produces the same deformation of copper is double the average or two-thirds of the computed maximum.

TABLE 12.—EQUIVALENT STATIC LOAD AND MAXIMUM FORCE FOR IMPACTS OF AN UNSPRUNG WEIGHT FOR VARIOUS HEIGHTS OF FALL AS MEASURED BY ½x½-IN. COPPER CYLINDERS.

No.	Free fall (H. F.).	Total height of fall (h).	Total cushion (d).	Equivalent static load.	Maximum force (computed).	Ratio equivalent static load to maximum force.
	Inches.	*Inches.*	*Inches.*	*Pounds.*	*Pounds.*	*Per cent.*
1	1.90	2.42	0.666	22,400	22,150	99.0
2	2.20	2.76	.700	24,400	24,000	98.5
3	3.42	3.004	.724	26,000	25,300	97.5
4	2.73	3.328	.745	27,500	27,260	99.0
5						
6	3.09	3.712	.760	28,600	29,760	104.0
7	3.34	3.980	.780	30,200	31,100	103.0
8	3.59	4.24	.797	32,700	32,450	99.2
9						
01	4.15	4.820	.808	33,000	36,400	110.0
11	2.00	2.512	.650	21,500	23,560	109.0
12	1.73	2.212	.623	20,000	21,640	108.0
13						
14	1.20	1.608	.553	16,500	17,740	107.5
15	1.03	1.424	532	15,600	16,320	104.6
16						
17	.463	.728	.407	11,100	10,920	98.5
18	.286	.472	.328	8,600	8,760	102.0

Unsprung weight (w) = 3,050 lb. Sprung weight = 0 lb.

Equivalent static load determined by use of ½x½-in. copper cylinders.

Average F is 102.5% of equivalent static load.

It will thus be seen that we have been able to express impact in terms of an equivalent static load and through this medium of expression we are enabled to compare the intensity of impact exerted on road slabs tested as already described.

In curve 3, Fig. 9, the equivalent static load is shown as given by the ½x½-in. copper cylinder. Curve 2 is the average curve developed from the space-time curves taken during the tests of different slabs at Arlington. Curve 1 is the curve worked out by the acceleration method for the equivalent static effect of the blow when no cylinder is used, and while there is no relation between the methods used for curves 1 and 2, they agree within about 5%.

The close agreement of curves 1 and 2 furnishes sufficient proof that a definite relation exists between the effect of impact force and equivalent static load. Curve 1 gives the relation between the equivalent static loads

(Continued on page 274)

Plant Inspection of Paving Material*

By GEORGE COBB†

The man who first said "An ounce of prevention is worth a pound of cure" undoubtedly had served an apprenticeship as an asphalt plant inspector. It is at the plant and not on the street that the "hot stuff" can either be made or broken.

Preliminary Inspection

Bearing in mind this "ounce of prevention" adage, we must begin our preliminary work before the paving material reaches the plant. First and most important, the source of the material itself must be known to the engineer in charge of the paving mixtures. Fortunate indeed is that engineer if his asphalt is to be purchased from a local refinery. Such being the case, he can have stills of A. C. run down to whatever penetration he desires under the joint control of the refinery chemist and one of his own men. Or if a "natural" asphalt is specified, the fluxing up to the required penetration is obtainable under the same inspection. To those who may have been forced to close down a paving plant, for some hours, in order to flux up or lower the penetration of a refractory kettle, such a method of predetermining the penetration is little short of a Godsend.

And so with a sand bank, or neighboring river bottom. Show me the bank that does not boast its own peculiar strata of dirt and clay! A watchful inspector at this point would cull out the dirt before it was loaded. Let this same inspector acquaint himself with the sand bars where the river sand is dredged. A word from him at the right time will prevent the captain of the dredge from sending up a whole scow load of improperly graded sand. Thus down the entire list of paving materials—the binder stone, the gravel, the filler. Become familiar with each brand of material itself, but, primarily, gain a full knowledge of the source of supply. By so doing, much valuable time can be saved and many heated arguments avoided.

Three Systems of Plant Inspection

There seem to be three common systems of plant inspection in use today. The first is that in which a municipality hires a private laboratory in some distant city to send on an inspector. This man may be experienced and capable, but at best it is a crude method, as he will be compelled to forward samples of his materials and mixtures to his home laboratory and await its decision before making any changes in his batch formula. In the meantime, many yards of improperly proportioned pavement will probably have been laid. The second method, and doubtless an improvement on the first, is to employ a company that will send a chemist with a field laboratory to the scene of action. It is obvious that under such an arrangement, needed corrections in the mixtures can be speedily effected. The third—and, to my mind, the best—method, is for the city or state to establish its own laboratory and organization. By so doing, the chemist in charge makes himself acquainted with all sources of material, places an inspector at each plant that is to operate and systematically keeps in daily touch with the plants and with the "hot stuff" in transit and while it is being laid on the street. He samples the mixture at the plant and from the street as well. With a capable laboratory force it is possible to get finished results of the composition of the mixture within three hours after taking the sample. At the plant, the inspector keeps a record of the total batches of material mixed and sent to the street. On the street, a second inspector keeps a daily yardage record. By determining the number of square yards of material that should be derived from each batch, at a given thickness after compression, it is possible for the chemist to make a daily check as to whether the finished mixture is being raked to too thin a depth.

At the Plant

At the plant itself the inspector has a wonderful opportunity to employ, among other things, good, hard common sense. All materials, immediately upon their arrival, are sampled by him and the laboratory notified. He is instructed after they have been examined as to the batch formula to employ. Now if the plant inspector will make it a point to especially see to it that the correct proportions of sand are fed and will balance his asphalt bucket after every two or three loads, surface mixtures will leave his plant with striking uniformity.

The failure of the mixer man to properly drain his asphalt bucket, or the other extreme, to run it over, is probably responsible for more irregularity in bitumen content than any other one reason. When "binder" is being turned out, it appears to be good practice to allow some little leeway to the mixer man. Say we are using a 15-ft. box and adding 15% of sand to the binder stone and have set the A. C. scales at 80 lb. For some six or seven batches this amount of A. C. may be exactly right. However, segregation is bound to occur in the aggregate storage bin with the result that the next batch may be deficient in fine material, the following one having an excess. It is apparent that in the one case 80 lb. is too much and in the other, not enough. Under the watchful eye of the plant inspector, allow the mixer man to use his own judgment to an extent. This may appear to be bad practice—the writer has seen more uniform binder laid, when mixed in this fashion, than where the bucket was actually balanced for each batch, as in the case of

(Concluded on page 274)

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*Paper presented at the 27th annual convention of the American Society for Municipal Improvements, Baltimore, Md., Oct. 25-28, 1921.

†Asphalt Material Engineer, Municipal Laboratory, Baltimore, Md.

GOOD ROADS
CONSTRUCTION TRANSPORTATION MAINTENANCE

Founded January, 1892

E. L. POWERS
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PARKING SPACE FOR MOTOR VEHICLES

Provisions for parking space for motor vehicles, as well as space for loading and unloading at the curbs, will have to be taken into account in the city planning and street design of the future. In addition, a far more difficult problem will have to be solved to provide such space in already built-up portions of towns and cities where the total width between buildings is too little to take care of the demands of modern urban street traffic. The latter is a particularly serious problem because of the very great mileage of narrow streets that are even now congested beyond the point of safety or convenience.

Motor traffic has reached such proportions already that at certain periods some of the principal business streets of the majority of towns and cities are unduly congested. The loading and unloading of goods carried in motor trucks contribute to the general crowding, but constitute a less serious factor, in most places, than does the use of motor cars. The motor trucks take the place of the horse-drawn vehicles formerly used, and the increased congestion is due more to the greater size of the motor trucks and to the normal increase in volume of business and in the number of business places than to the change in the type of vehicles used. In the matter of passenger traffic, however, an entirely different condition obtains.

When horses furnished the motive power for passenger transportation over the highways comparatively few people drove to business. But since the coming of the relatively low priced motor car, many people, especially in towns and medium sized cities, have adopted the custom of driving to offices, stores and factories, parking their cars in adjacent streets. Moreover, the ratio of motor car owners to the total population is probably greater than was the ratio of horse owners to the total—particularly in urban communities.

Just as the utility of the motor vehicle for inter-city and rural transportation depends upon good roads, so does the utility of the car in towns and cities depend upon parking facilities. Car owners are going to demand parking spaces near their places of business, near churches and theaters, near stores and public buildings, near railroad stations and piers, and near an almost endless list of public gathering places. And because car owners constitute a large and ever growing percentage of the taxpayers, it is going to be necessary to meet their demands.

The problem is essentially an engineering one, and highway engineers, especially those in the street departments of cities and towns, are the ones who will have to find the solution.

Width of Roads There is much food for thought in the extract from the "Missouri Road Bulletin," entitled, "Is There Danger in Narrow Highways?" which is printed on another page of this issue. Determining the future traffic on a given road is one of the most difficult of the highway engineer's problems, yet it is one that must be solved if roads are to be planned and designed intelligently.

Federal Aid Road Types More miles of gravel roads than of any other one type were built by federal aid during the past four years and four months, according to a recent statement from the Department of Agriculture. The mileages of the several principal types built with federal aid, arranged in descending order, are as follows: Gravel, 10,043.5; graded and drained, 6,864; cement concrete, 4,653.6; sand-clay, 2,695.5; bituminous macadam, 1,323.2; bituminous concrete, 772.5, and brick, 444.6. The greatest expenditure was for cement concrete roads, with others as follows: Gravel, graded and drained, bituminous macadam, sand-clay, bituminous concrete, brick.

Few are Really Appreciative A recent number of the New Jersey State Highway Department's publication, "The Highwayman," contains an admonition to the public that might well be passed on to road users by other road builders. It appears at the top of a tabulation of road jobs completed or contracted for during the current year, and is as follows: "If the work which the Highway Department is doing could be *concentrated in one place,* you road users could get some adequate idea of the magnitude of the job which a year's road work means. Spread, as it is, over hundreds of square miles, most people never see more than a fraction of it. Study the table below, and learn at least of the new roads in your own section of the state."

FEDERAL AID ROAD EXPENDITURES

In Past Four Years and Four Months Total Expenditure has Amounted to $211,135,276.31 of Federal Money and Total Mileage Built to 28,135

During the four years and four months ending Nov. 1, and covering the period back to the inception of federal aid work under the present system of supervision, the Government has expended $211,135,276.31 in federal aid work in connection with the construction of 28,135 mi. of highways, according to a summary recently completed by the Bureau of Public Roads of the Department of Agriculture.

The total cost of the work done has amounted to $496,151,683.43, and the average cost has been $17,630 per mile.

Practically 36% of the federal funds, or $75,600,279.30 was used for the construction of 4,653.6 mi. of cement concrete roads. The mileages of other types of roads built by federal aid and the amounts of federal funds used for the work were as follows:

Gravel, 10,043.5 mi., $47,192,895.41; graded and drained roads, 6,864 mi., $24,721,020.92; bituminous macadam roads, 1,323.2 mi., $18,646,066.17; bituminous concrete roads, 772.5 mi., $9,299,864.32; brick roads, 444.6 mi., $6,925,482.13; sand-clay roads, 2,695.5 mi., $10,495,172.10.

Recommendations for Increased Road Building by Conference on Unemployment

(Concluded from page 266.)

priation. This federal money is not available because of the delay in Congress. This means that Minnesota's proposed winter program must be seriously cut, if not stopped. The stoppage of road building in the state will mean that more than twenty thousand men and hundreds of teams will be thrown out of work. There is no hope for this labor in Minnesota's iron mines and lumber camps this winter. Both will be closed. Unless Congress acts promptly the state will be forced to add thousands of men to the unemployed of the United States.

This is one example. There are others. In Pennsylvania 250 mi. of projected road are now held up by the delay in Congress. This means that many thousands of men who might be at work are unemployed. In Georgia, funds amounting to $16,000,000 are available as soon as the federal appropriation is made that can not otherwise be touched.

While this committee was at work on this report the Secretary of Commerce received a telegram from the Governor of Mississippi in which he said: "Relief from unemployment in Mississippi could almost be immediately secured by the passage of legislation before Congress making available additional federal money as federal aid to the state for highway construction. Our counties have on hand available for road construction sufficient funds to meet any funds made available as federal aid. They are delaying putting the work under construction until such time as it is definitely settled whether or not they will receive cooperation from the Federal Government. I believe a comprehensive program of highway construction such as would be started by the passage of impending federal legislation would solve to a large extent the unemployment situation in Mississippi."

But while Congress is responsible for the curtailment and the possible stoppage of the road building program in some states, in other cases the states themselves have fallen behind. Although they have taken care to fulfill all the conditions required in order to receive their share of the money appropriated by Congress they are not going ahead with work.

The State of New York, for example, now has available about $7,000,000 of federal aid for road building. That means if it carried out promptly its contract with the Government it could put $14,000,000 at least to work—a sum which would employ many thousands of men. The State of Indiana has available for new road construction $4,500,000 of federal aid. Its own highway policy and the failure of its Legislature to match the federal grant are holding it back.

This committee wishes to point out to the states that have fallen behind in road making that their delay is complicating and intensifying the whole unemployment situation. They are obligated, morally at least, by their acceptance of federal aid to use at once all the money made available to them by the Government. The chief reason for giving it to them was to prevent and relieve unemployment. Every dollar tied up by a state now is a dollar turned from its rightful purpose in checking unemployment.

The committee likewise would urge upon Congress the importance of at once making a liberal appropriation for road building. In our judgment the road building program throughout the whole country hinges upon this action. Stop your road building, as some of the states fear that they will be forced to do now, and you shut down quarries, cut off a market for cement and other materials, take freight from the railroads. Minnesota estimates that for every man she keeps busy on road construction, three others are employed in the work of preparing and transporting materials. For every mile of paved road she builds, a hundred and forty-one carloads of freight are moved. That is, road construction means occupation in many industries.

It is the judgment of this committee that the country should put itself behind the BETTER ROADS-MORE WORK PROGRAM, insisting that it be pushed at once to the last dollar of money that is available.

The Delaware State Highway Department has announced that the 1922 construction program contemplates the expenditure of $2,250,000. The first letting of contracts is to be held late in February.

THE NEED OF REFORM IN ROAD BUILDING AND NATIONAL TRANSPORTATION

Coordination of All Existing Forms of Transport and a Big National Road System Needed

By SAMUEL HILL*

The need of reform in road building and highway transportation, a subject that will receive extended discussion at the good roads congress to be held under the auspices of the American Road Builders' Association at the Coliseum in Chicago, January 17 to 20, next, is one of vital interest to the people of the United States at this time. It is a subject that should receive the earnest consideration of every good roads advocate, every statesman and every public official who has the welfare of the country at heart and who wants to see the United States lead the world in cheap transportation facilities.

For forty years I have been interested in highway improvement in the United States, and to my mind the most important thing which the United States needs to do is to correlate its transportation system. Abroad, in many countries, there is a cabinet minister who has the title of Minister of Ways and Means of Communication. Water transportation, rail transportation and highway transportation should be fitted together in such a way as to best serve the public needs. There are materials, but few people can think of them, that do not move over highways before they reach the water or the railroad. Destructive competition is unwise and unnecessary. America began first of all by using highways. The capital of every state in the Union at one time, except Florida, was located on a watercourse. The development of steam power caused the abandoment of the policy of highway improvement inaugurated with the Old Cumberland Pike. Puffing Billy, on the Baltimore & Ohio Railroad, superseded the wagon train. Today Puffing Billy sees coming over the hard surface road, provided at public expense, what he regards as a competitor. So far has that fear grown that the railway men recognized, when they threatened to strike, that the country could exist without them.

The stone masons and the brick masons, feeling that they had the construction of the buildings under their control, diminished the effectiveness of their work and raised their prices, and today the stone cutter is a rarity. Concrete superseded brick and stone. It is well for our railroad brethren to bear this in mind.

Transportation is the measure of civilization. Every nation has increased in wealth and its workers have received high wages, just in proportion as its transportation systems have been multiplied. The lowest wage rate today in the world is in China. There is not one single mile of highway in China. The average highway in China is 15 in. wide. There is not one single mile of paved street in Japan.

America's danger is that we will duplicate unnecessary means of transportation. Every one of the three is essential, but all should be correlated and welded into one machine to get the best results. If we fail to do this we will pay bitterly for it. You cannot get along without railways or waterways, and latterly we have come to understand what highways mean.

Today England is laying an 18-in. concrete base for all the roads of England. On top of that they are putting Tarmac. Over those roads they haul what they call steam lorries or traction engines, each engine pulling perhaps three cars holding five tons each. The railways have complained to Parliament, and Parliament is taxing those motor buses, so as to more equitably distribute the burden.

The United States has had the cheapest transportation in the world. Outside of the Great Lakes it has lagged behind in water transportation, and only within recent years, since the American Road Builders' Association was formed, has the matter of proper highway transportation been taken up. With our increasing population the problem of the production of food will become acute unless proper study of soils be made. This is now being undertaken by our government, but heretofore the matter of road and highway legislation has been haphazard, without definite plan. There should be undertaken at once by the National Government a thoroughly planned system of national highways, and these should be so laid out and constructed as to give the largest possible use of existing railways, highways and waterways. There are in the United States approximately 2,500,000 mi. of alleged highways. There are 250,000 mi, substantially, of railways. The cheapest cost of moving a ton a mile on the Great Lakes was .9 mill, as demonstrated in the movement of ore by the Albert B. Wolvin. The cheapest form of transportation known was on the Cheasapeake & Ohio Railway, where coal tonnage was moved to tidedater for 1.1 mill per ton per mile. The cost of moving a ton per mile on the different classes of highways in the United States has not yet been accurately determined. We must elaborate some system of determining the cost of making transportation. It is a commodity like boots and shoes, dry goods or flour. When this cost is determined it must be ascertained just what proportion of the tonnage required can most efficiently be moved over the highways, over the waterways and over the railways; and this tonnage, when so determined, must be moved by the least expensive route. The probelm is to get the mouth to the food or the food to the mouth.

When we began highway improvement in the United States 40 years ago, there were approximately 60% of the people of the United States on the land. Today it is doubtful if on the farms proper there is to exceed 20% of the people. Every strong nation has its roots in the soil. The problem is to put people back on the land and keep them there. Otherwise our form of government will fail. To keep them there we must give them good roads, good telephone service, good rural free delivery and good schools and then find a market where they can sell what they raise at a profit.

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*Honorary Life President, Washington State Good Roads Association; Honorary Life President, Canadian Good Roads Association; Ex-President, American Road Builders' Association.

The trend toward town life has increased enormously, both here and in other countries. And unless we can make the comforts of home life on the farm at least equal to those in town, we cannot hope to progress as a nation. The farmer will no longer consent to work 10, 12 and 14 hours a day when the man in town is working 8.

With the return of our soldiers from the Great War the fact of their unwillingness to return to the land became evident. In other words, the habits of the farm boy had been lost. Unless we are willing to discover some way to restore labor to the farm, we shall be compelled either to import food or to import labor to produce food. The permanent importation of farm labor has always proven disastrous to any nation that has tried it.

Tests of Impact on Pavements by the Bureau of Public Roads

(Continued from page 269.)

as shown by the copper cylinders while curve No. 2 is twice the average impact forces as computed from theoretical formulæ. The difference between curves 2 and 3 represents the effect of the copper cushion. The ½x½-in. copper cylinder values corrected by these differences represent the equivalent static loads which could be expected if no cylinder were used. From the foregoing it can be seen that there is ample evidence to warrant the assertion that the force of impact blows as delivered by the road impact machine can be expressed as an equivalent static load and thus is secured a means of comparing the resistances of pavement sections when subjected to impact.

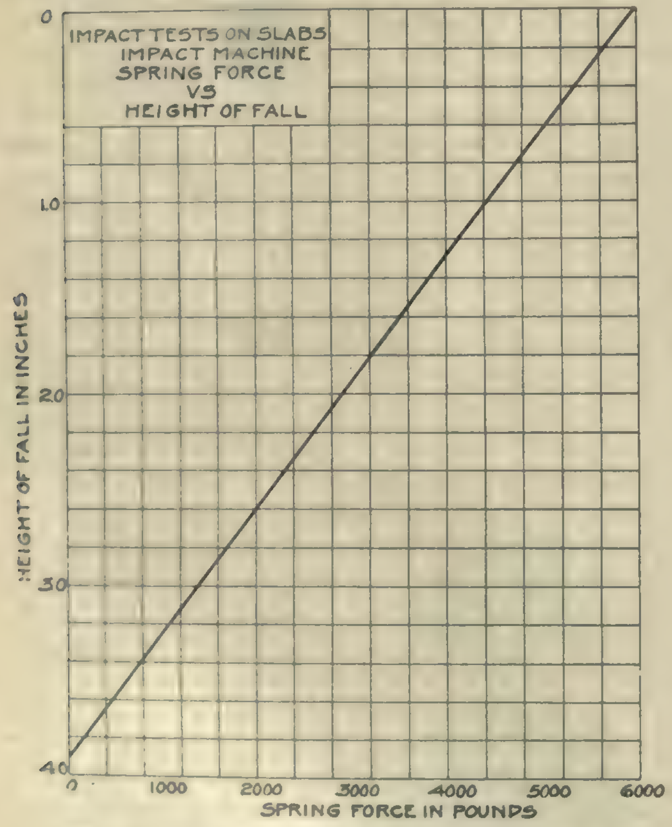

FIG. 10.—AVERAGE SPRING PRESSURE FOR VARIOUS HEIGHTS OF FALL

(To be continued)

Plant Inspection of Paving Material

(Concluded from page 270)

the surface mixture. The inspector would do well to go slowly about changing the proportions of sand he is feeding. It is very easy to secure an unrepresentative sample from the hot sand bin. Let him verify his first screening before making a change. Otherwise he may hopelessly unbalance his mixture by snap decision changes. Another important point to bear in mind—even a good cook may burn her bread—the oldest drum fireman in the game may lose control of his temperatures. When this happens the inspector should have the aggregate bin emptied entirely before any material is mixed. The blended sands may thus be used again. Once the A. C. is added, the mixture must be condemned and represents a total loss.

Conclusion

There are many practical "pointers" about the operation of an asphalt plant that can be gained by experience but let me emphasize the fact that, once the fitness of the materials is determined before allowing them to reach the plant, the battle is half won.

Federal Aid Law Stimulates Road Work in Nevada

The enactment into law of the federal aid measure makes necessary extensive preparations for future work in many states. In Nevada the State Highway Department has already started upon the work of determining the policies to be followed.

"The Phipps Bill," according to a statement in a recent issue of the "Nevada Highway News," the publication of the State Highway Department, "contains some very radical departures from many features of the old federal aid law of 1916 and amendments, and under these features it is necessary that the department formulate and adopt policies new and entirely different in many instances from those in effect in the past.

"Before the department can proceed with the adoption of these policies it is necessary that a full interpretation be had by the state of the new regulations of the Secretary of Agriculture governing procedure under the bill. The Bureau of Public Roads, in turn, must submit to the solicitor of the Department of Agriculture for interpretation certain features of the bill as a basis for such new regulaions and the department must hold conferences with representatives of the Bureau of Public Roads in order that a mutual understanding may be had of the application of certain clauses of the bill to conditions within Nevada."

The Nevada State Highway Department expects that several weeks will be required to complete the necessary preliminary work, but that by Jan. 1, 1922, or shortly thereafter, the 1922 program of the department should be fully outlined and the department ready to proceed thereunder.

NEW JERSEY BODY AUTHORIZES BRIDGE AND TUNNEL BONDS

At a recent meeting the New Jersey Interstate Bridge and Tunnel Commission authorized the issuance of bonds to the amount of $15,000,000 to meet 1922 expenditures on the Hudson River Vehicular Tunnel and the Delaware River Bridge.

New Jersey's share of the tunnel expenditures for the year will amount to $12,793,000, according to estimates by Chief Engineer Holland. The state's share of the bridge expense is expected to be about $2,500,000.

The commission also authorized the beginning of negotiations for the acquiring of land for the tunnel construction plant.

IS THERE DANGER IN NARROW HIGHWAYS?

Building roads for future traffic is an experiment. Who knows today what the building of a better road will mean in the way of increased usage of such road? Guesses are made on local roads and the result may be somewhere near accurate. But on through highways that cross the state who will say what the traffic will be when they are completed and who can guess what it will increase to within a 10-year period?

Then the question arises first, what width should the roads be constructed? Does not the new law with a minimum width of 40 ft. fail to take in a congested traffic? The gravel roads must be not less than 12 ft. in width, so far as the surface covering is concerned. Is that not too narrow for a gravel road built upon any course mapped out between county seats in this state?

In the East it is being discovered now that the roads constructed less than five years ago are inadequate for the traffic, so far as their width is concerned, and many states are at a loss in widening them. The increased use of the roads bring greater value to the country along these highways. Securing a right of way for additional width means the expenditure of much more than was necessary five years ago when the roads were first projected.

For instance, the highway between New York City and Philadelphia has become such a congested thoroughfare that it is deemed necessary now to build the roadway a width of 120 ft. If such conditions can be found in the East it is only a question of time until similar conditions will be found in Missouri. For that reason the State Highway Department will give serious thought to the width of roads and it may be necessary to secure additional ground for rights of way before a road project will be sanctioned.

Statistics can be secured governing nearly all activities, but no statistician has, as yet, figured out how largely a new highway will be used when opened for traffic. With three or four cross-state highways in Missouri, who will be able to tell which will be the most popular? Which will take the bulk of the long-distance tourist traffic from New York and Boston to San Francisco or Los Angeles and back again? Is there a dreamer with vision enough to see the scurrying automobiles traversing any one of these better class roads and figure how many hundred or how many thousand tourists will pass across the state each day? Those who live upon a route that is now used extensively are themselves amazed at the flood of cars that pass their doors. With high-type roads and better and more automobiles, what will it be five years from now?—Missouri Road Bulletin.

CALIFORNIA HIGHWAY COMMISSION TO TRY SUB-SOIL TREATMENTS

The California Highway Commission is planning to test several methods of treating sub-soils on which pavements are to be laid.

The experimental work will be done on a road being built between Denverton and Rio Vista in Solano County. Nine 500-ft. sections are to be treated by plowing, harrowing and compacting, and in some cases mixing foreign materials with the soil. The soil will be treated to a depth of 6 in. on some sections and to a depth of 12 in. on others. The materials to be mixed with the soil are Portland cement, hydrated lime, pulverized limestone, and asphaltic road oil.

◆

One Hundred and Six Prisoners have Escaped from Prison Road Camps during the four years the State of Missouri has been using convict labor on road work. It is estimated that it cost $100 for the return of each prisoner and now only "trusties" are sent to the camps and then virtually under no guard.

The 40,000 mi. of Roads in the Province of Quebec occupy an area of 320,000 acres, which at $50 an acre make a value of $16,000,000, according to S. L. Squires, Chairman of the Executive Committee of the Canadian Good Roads Association. The cost of work done on the highways prior to 1912 aggregated $40,000,000, while the amount spent by the province since that date has amounted to $30,000,000. This constitutes a total investment in Quebec roads of $86,000,000. The number of automobiles entering Quebebc in 1920 totalled 34,435, and it is estimated that these foreign cars left no less than $33,867,200. It is expected that when the final figures for 1921 are compiled this amount will total approximately $35,000,000.

MEETINGS

Calendar of Coming Meetings

Jan. 17-20, 1922—American Road Builders' Association.—Nineteenth Annual Convention, Twelfth Americal Good Roads Congress and Thirteenth Good Roads Show under the auspices of the A. R. B. A., The Coliseum, Chicago, Ill. Secretary, E. L. Powers, 11 Waverly Place, New York, N. Y.

Feb. 13-16, 1922—American Concrete Institute.—Annual Convention, Cleveland, Ohio.

BOARD OF DIRECTORS OF THE AMERICAN ASSOCIATION OF ENGINEERS

Steps toward the opening of an educational campaign for the improvement of municipal engineering service were taken at the quarterly meeting of the board of directors of the American Association of Engineers held at Chicago, Ill., on Nov. 18 and 19. The specific objects of the proposed campaign are: (1) More certain tenure of office; (2) the supervision of technical engineering work by engineers; (3) the putting of compensation on a basis of qualifications and service rendered; (4) insistence upon the acceptance of only the highest grade of engineering work; (5) extensive cooperation with local civic organizations, and (6) the encouragement of engineers to prepare popular articles on paving, city lighting, city planning and other municipal work.

The New England Road Builders' Association will hold its first annual dinner at the Hotel Somerset, Boston, Mass., on Dec. 15.

PERSONAL MENTION

John L. Elliott has been appointed city civil engineer of Indianapolis, Ind.

D. L. Struthers has been appointed highway engineer of Gaston County, North Carolina.

T. J. Powell has been appointed assistant county engineer of Union County, New Jersey.

Carl T. Bowen has been appointed engineer and superintendent of roads of Ottawa County, Michigan.

George F. Baker, formerly city engineer of Dayton, Ohio, has been appointed service director of that city.

C. P. Hicks, of Centralia, Wash., has been employed by the City Council of Pe Ell, Wash., as engineer of construction.

Ivan E. Houck has been appointed city engineer of Dayton, Ohio, succeeding George F. Baker, who has been appointed service director.

H. J. DeSavigny of the Department of Highways of the Province of Saskatchewan has been transferred from Weyburn to Swift Current.

Ray Sperr has resigned as engineer of Keweenaw County, Michigan, and has entered the employ of the Wisconsin State Highway Commission.

Harry L. Maier has been appointed chief engineer of the Street and Sewer Department of Wilmington, Del., succeeding Edgar M. Hoopes. Mr. Maier was formerly engineer in charge of sewers.

H. E. Surman has been appointed engineer in charge of design with the Division of Highways of the Illinois Department of Public Works and Buildings. He was formerly a district engineer of the department.

Paul J. Blunden has been appointed an assistant division engineer of the West Virginia State Road Commission, with headquarters at Martinsburg. He was formerly county engineer of Boone County, West Virginia.

H. G. Shulde, who has been serving as acting district engineer of the Pennsylvania State Highway Department in District 18, has been appointed district engineer of District 3 and transferred from Bedford to Sunbury. District 3 includes Columbia, Montour, Northumberland, Snyder, Sullivan and Union Counties.

OBITUARY

Charles M. Shipman, for the past 16 years superintendent of streets of Newark, N. J., died recently at his home in that city. Mr. Shipman was 75 years old.

George L. Burrows, Sr., president of the Niagara Falls International Bridge Co., died recently at his home in Saginaw, Mich., aged 85. He was elected president of the Niagara Falls International Bridge Co. in 1865, succeeding his fther, Lorenzo Burrows. He is survived by one brother and five sisters.

Frederick Wilhelm Cappelen, a widely known municipal engineer, died recently at his home in Minneapolis, Minn., at the age of 63. He was born at Fredrikstad, Norway, and after studying in his native land, went to Germany where he attended the University of Dresden, completing a course in bridge engineering. He then came to New York and entered the employ as bridge engineer of the Northern Pacific Railway. He was a member of the Minneapolis City Council and was appointed by Herbert Hoover to membership in the American Engineering Council Committee on Classification and Compensation of Engineers of the Government, Municipalities and States.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

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Concrete Roads must be Reinforced

It is demonstrated beyond doubt that to make concrete roads proof against heavy motor traffic, weather and time a fabric of steel must be incorporated in the concrete.

Several great States have so ruled.

American Steel and Wire Company's

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Send for our book on road building

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Fort Fisher Highway, New Hanover Co., N. C. Treated with "Tarvia-B" 1915 · 17 · 18 · 19 · 21 and "Tarvia-A" in 1916.

Above is Wrightsville Turnpike, New Hanover Co., N. C. Treated with "Tarvia-A" 1915, and with "Tarvia-B" 1917 and 1921.

Another view of Fort Fisher Highway

"The Best Investment The Board Ever Made"

Mr. Addison Hewlett, Chairman of the Board of Comissioners of New Hanover County, N. C., writes, under date of July 25, 1921:

"We have been using Tarvia for surface treating the macadam roads of New Hanover County for the past six years, and we find this treatment satisfactory in every respect.

"Before we started the use of Tarvia we had great difficulty in maintaining our roads, as they became very dusty in dry weather and washed away in wet weather, leaving our road surface full of holes and ruts. Since using Tarvia the surface of the road has been well protected in all kinds of weather, and today our roads have smooth, hard surfaces and our maintenance problem has been very easily solved. The Tarvia treatment is very inexpensive.

"It is unquestionably the best investment the Board of Commissioners has ever made and the Commissioners would not consider for a moment discontinuing Tarvia on our roads."

Tarvia

For Road Construction Repair and Maintenance

Additional comments on Tarvia are made by R. A. Burnett, County Superintendent of Roads:

"Tarvia treatments are given to some of our roads every year while other roads, such as the Wrightsville Turnpike, have lasted as long as three years before requiring another treatment.

"These treatments have cost us in the neighborhood of $300 per mile per year and have proved to be the best, easiest and cheapest method of maintaining our roads. We have always had the best of co-operation from your engineers . . . . .

"We feel that we have a finer system of roads than any other county in the State."

No matter what your road problem may be—new construction, maintenance, or repairs—there is a grade of Tarvia made especially for the purpose.

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Johnstown
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GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

WITH WHICH IS INCORPORATED

THE HIGHWAY CONTRACTOR AND ROAD BUILDER

Vol. LXI. NEW YORK, N. Y., DECEMBER 21, 1921 Number 25.

Standard Tests for Non-Bituminous Materials*

Your Committee on Standard Tests for Non-Bituminous Materials herewith respectfully submits its 1921 report.

Your Committee recommends that the society adopt methods of testing non-bituminous materials which have given useful, satisfactory and reliable results. It further considers that it is highly desirable that methods of conducting different tests in different laboratories should be as uniform as possible. Hence, it is obvious that, as far as practicable, methods of testing adopted by national organizations should be identical. Based on the above hypotheses, your committee has given careful consideration to the tests adopted by the American Society for Testing Materials, and those proposed by Committee C-9 on Concrete and Concrete Aggregates and Committee D-4 on Standard Tests for Road and Paving Materials of the American Society for Testing Materials and by the Special Committee on Materials for Road Construction of the American Society of Civil Engineers.

Your committee recommends that the Society tentatively adopt, until the 1922 convention, the following methods of testing:

Apparent specific gravity of sand, stone and slag screenings, and other fine non-bituminous highway materials, as described in the Am. Soc. Test. Mat., 192 Standards, pages 715-718, and designated D 55-19.

Apparent specific gravity of coarse aggregates, as described in the Am. Soc. Test. Mat., 1921 Standards, pages 713 and 714, and designated D 30-18.

Mechanical analysis of sand or other fine highway material, as described in the Am. Soc. Test. Mat., 1921 Standards, pages 721 and 722, and designated D 7-18.

Mechanical analysis of mixture of sand or other fine material with broken stone or broken slag, as described in the Am. Soc. Test. Mat., 1921 Standards, page 724, and designated D 19-16.

Mechanical analysis of broken stone or broken slag, as described in the Am. Soc. Test. Mat., 1921 Standards, page 723, and designated D 18-16.

Abrasion of road material, as described in the Am. Soc. Test. Mat., 1921 Standards, page 710, and designated D 2-08.

Toughness of rock, as described in the Am. Soc. Test. Mat., 1921 Standards, pages 711 and 712, and designated D 3-18.

Crushing strength of rock or slag, as described in the Am. Soc. C. E. Trans., Vol. 82, 1918, page 1442.

Cementation of rock, slag, and gravel powders, as described in the Am. Soc. C. E. Trans., Vol. 82, 1918, pages 1441 and 1442.

Quantity of clay and silt in sand for highway construction, as described in the Am. Soc. Test. Mat., 1921 Standards, page 720, and designated D 74-21.

Quantity of clay and silt in gravel for highway construction, as described in the Am. Soc. Test. Mat., 1921 Standards, page 719, and designated D 72-21.

Organic impurities in sands for cement concrete, as described in the 1921 Report, Com. C-9, Am. Soc. Test. Mat., page 12, and desiganted C 40-21 T.

Tests for Portland cement, as described in the Am. Soc. Test. Mat., 1921 Standards, pages 530-547, and designated C 9-21.

Workability of concrete for cement concrete pavements, as described in the Am. Soc. Test. Mat., Procs., Vol. 20, 1920, page 692, and designated D 62-20 T.

Compression test of cement concrete, as described in the 1921 Report, Com. C-9, Am. Soc. Test. Mat., pages 6-11, and designated C 39-21 T.

Paving brick rattler test, as described in the Am. Soc. Test. Mat., 1921 Standards, pages 567-574, and designated C 7-15.

Absorption of water by wood blocks after treatment, as described in the Am. Soc. C. E. Trans., Vol. 82, 1918, page 1447.

The committee requests that all specification committees and members of the Society interested in tests for non-bituminous materials give careful consideration to the methods recommended and submit to the chairman of the committee, prior to July 1, 1922, criticisms and suggestions relative to the proposed methods of testing, in order that the next convention may be in a position to adopt, as standards, methods of testing covering all test requirements included in the Society's specifications for non-bituminous materials.

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*Report of the Committee on Standard Tests for Non-Bituminous Materials of the American Society for Municipal Improvements, submitted at the 27th annual convention of the Society, Baltimore, Md., Oct. 25-28, 1921.

Committee: Arthur H. Blanchard, Chairman; Thomas H. Brannan, Wallace L. Caldwell, Austin B. Fletcher, Clarence D. Pollock.

Your committee believes that the primary function of the Special Committee on Standard Tests for Non-Brituminous Materials is to serve the Society as a committee to review new methods and modifications of present methods of testing non-bituminous materials and to recommend to the Society, from time to time, the adoption of standards and changes in such standards as may seem desirable.

Tests of Impact on Pavements by Bureau of Public Roads—VI. [*]

Methods of Testing Pavement Slabs Under Impact—Results of the Tests

By C. A. HOGENTOGLER[*]

(Continued From December 14)

The first article of this series (comprising the installments already published) was devoted to a description of the methods employed in making the tests of impact on the various pavement slabs, a discussion of the relation between impact force and equivalent static load as measured by the copper cylinders, and to the development of a method by which the force of impact, eliminating the effect of the cushion provided by the copper cylinders, can be computed from the space-time curves.

This article (comprising this and the following installments) reports the behavior of the various pavement slabs in terms of the impact force which they sustained, the forces being computed from the space-time curves by the method previously described.

As previously described, the slabs were first subjected to 500 blows from an initial height of ⅛ in., taking a space-time curve of the first 5 blows and measuring the settlement of the slab after the 250th. The testing was then continued for 250 more blows without setting the machine for a new height of fall, and space-time curves were again taken for the first 5 blows, measuring the settlement after the last blow. Beginning with the 500th blow the height of fall was increased by ⅜ in. and two sets of 250 blows each were delivered at this height making space-time curves and taking elevations for settlement as before. The manner in which the height of fall was increased after each 500 blows has already been described.

The relative behavior of the slabs is expressed concretely by the computed impact force to which each specimen was subjected before and after the first crack developed, but in comparing the slabs it was necessary to consider also the number of blows delivered, the height of fall, the rate of settlement of the center of the slab, the character of the failure and the moisture content and supporting value of the subgrade.

First Crack the Criterion of Failure

Failure was considered to have occurred with the first crack, but in some cases it was difficult to determine the exact height of fall and corresponding impact which the slab would resist. The difficulty was caused by the fact that the slab would resist the 500 blows from a given height and crack and begin to settle very soon after the height of fall was increased. Thus while it can be said with certainty that the slab resisted the lesser impact and failed under the greater, the least impact which would have caused failure was not ascertained, and it can only be said that it lies between the values corresponding to the two heights of fall. In other cases, slabs would resist several hundred blows from a given height and then break. In such cases the exact height of the drop that caused the failure could be ascertained by adding to the height of fall at the beginning of the series of 500 drops during which the failure occurred, the settlement of the slab which occurred after the height was increased. For example, if a slab failed at 900 blows the height of fall at failure was determined by adding to the height of fall as measured by the autographic curve at 750 blows the center settlement which occurred between 750 and 900 blows.

The most difficult cases to interpret were those of the bituminous-filled brick sections which failed by cracking of the base under the ⅛-in. drop. The difficulty in these cases was due to the fact that there was no discernible crack and the height of fall which caused failure could only be assumed from a study of the rate of settlement.

In adopting the first crack as the criterion of failure it is necessary to remember that the character of the failure and the behavior of the pavement after initial cracking also give important indications of the value of the slab. Cracks in a rigid surface might not be injurious so long as it is not broken into small pieces by continued pounding. The bearing value of the subgrade must also be considered in interpreting the results of the tests.

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[*] From "Public Roads," the official publication of the Bureau of Public Roads, U. S. Department of Agriculture, November, 1921.

[†] Highway Engineer, Bureau of Public Roads, U. S. Department of Agriculture.

The Test Data Explained

For purposes of comparison the various sections are grouped into four general divisions according to type of construction as follows:

1. Concrete surfaces.
2. Monolithic brick surfaces.
3. Brick surfaces on concrete bases with 1-in. sand-cement cushions.
4. Brick surfaces on concrete, macadam, and earth bases with sand and screening cushions.

The various sections in each group are compared with each other, but no attempt has been made to compare pavements of different type.

For each group a table has been prepared which gives in concise form the data necessary for the comparison of the several sections comprising the group. (See Tables 1, A, B, C, and D.)* The height of fall given in these tables is the maximum drop which the slab resisted and corresponds to the forces given in the column headed "Computed resistance." The values given in the column headed "Failure" correspond to the height of fall which was observed to cause failure. Where it could be ascertained that the drop at which failure occurred was the least that would produce the result the figures given in the two columns are identical. Both sets of values are taken from curve 2 (Fig. 11) which expresses the relation between height of fall and impact force. The methods by which the penetration index of subgrade bearing value and the moisture content were determined were described in the preceding article.

In addition to the tabular comparisons the condition of each section after failure is shown by means of photographs in Figures 12, 13, 14, 15 and 16;** the settlement of the various sections under the blows is shown in the curves of Fig. 17; and a brief paragraph is given to a description of the behavior of each section under test.

Comparison of Concrete Surfaces

In this group of sections are slabs 2, 4, 6, 8, and 10 in. thick. Their center settlement curves are shown in Fig. 17 and the figures representing their resistance to impact are given in Table 1A. Photographs of representative failures are shown in Fig. 12.

Section No. 18. Concrete, 1:1½:3 mix, 2 in. thick, on wet subgrade. This slab was not tested. It cracked through the middle before the test could be made. The fact that three concrete beams each 1 ft. wide and 6 in. thick, with a total weight of approximately 1,000 lb., rested on the slab during the winter is possibly responsible for the failure.

Section No. 115. Concrete, 1:1½:3 mix, 2 in. thick, on dry subgrade. This slab offered little or no resistance to the ⅛-in. drop, developed the first crack after the 10th blow, followed by rapid punching out at the center. The condition which resulted after 51 blows is shown in the photograph, Fig. 12. It can be said that the slab resisted 7,800 lb. static load, the weight of the plunger. The settlement of 1 in. occurred after 30 blows. It can readily be seen that a surface of this thickness can be of little value for road purposes.

Section No. 17. Concrete, 1:1½:3 mix, 4 in. thick, on wet subgrade. This slab received a total of 634 blows, 500 beginning with ⅛-in. drop and 134 beginning with ½-in. Although cracks were not observed until after the 500th blow it is evident from the curve, Fig. 7, that failure commenced somewhere between 250 and 500 blows. This failure is assumed to have occurred on a 0.204-in. drop, which was the height of fall at the 400th blow, the corresponding force for which is 14,900 lb. The result after 634 blows was a badly broken slab with the center punched out. Settlement of 1 in. occurred after 600 blows.

Section No. 113. Concrete, 1:1½:3 mix, 4 in. thick, on dry subgrade. This slab withstood 500 blows beginning with ⅛-in. drop, and failed during 441 blows beginning with ½-in.; the first crack was observed after the 540th blow. The actual resistance was somewhere between 12,800 and 20,400 lb., the values corresponding to the total drop at the end of the first 500 blows and the ½-in. drop, respectively. Settlement of 1 in. occurred after 770 blows. From both curves and photographs it can be seen plainly that No. 113 offered considerably more resistance than No. 17. Since the two slabs are of the same mix and thickness, the difference in their behavior must be due to the difference in support offered by the subgrades. Table 1-A shows that the penetration of the bearing value determinator was 2.15 in. around No. 17 and only 1.15 around No. 113. The rates of settlement as shown by the curves also indicate that there was better support under No. 113 than under No. 17. Consequently it was to be expected that the former would show the greater resistance.

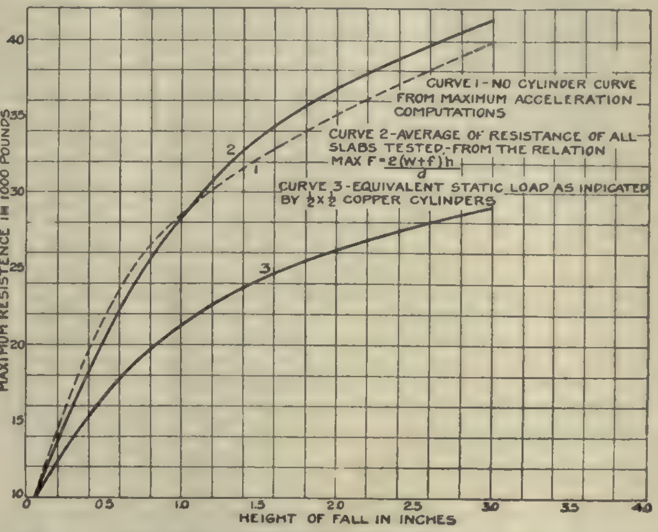

FIG. II.—CURVES SHOWING THE RELATION OF COMPUTED VALUES OF STATIC EQUIVALENT LOADS AND THE STATIC EQUIVALENTS AS MEASURED BY COPPER CYLINDERS.

TABLE 1-A.—TESTS OF CONCRETE SURFACES.

Slab No	Size	Thickness.	Mix.	Percent of moisture.	Bearing value, penetration 50 blows.	Computed resistance.	Height of fall	Force at failure.
	Feet	*Inches*			*Inches.*	*Pounds.*	*Inches.*	*Pounds.*
18	7 x 7	2	1-1½-3	....	....	....	....	....
115	7 x 7	2	1-1½-3	18.4	1.50	7,800	....	....
17	7 x 7	4	1-1½-3	21.2	2.15	14,000	0.204	14,000
113	7 x 7	4	1-1½-3	18.4	1.15	12,800	.162	20,400
16	7 x 7	6	1-1½-3	21.2	1.92	23,700	.677	26,700
15	14 x 14	6	1-1½-3	....	....	42,400	3.000	42,400
112	7 x 7	6	1-1½-3	20.2	2.67	21,600	.555	26,700
111	14 x 14	6	1-1½-3	22.7	3.20	28,000	.975	31,300
						38,900	2.410	......
						23,900	.658	26,700
19	7 x 7	6	1-3-6	21.2	3.31	21,900	.575	26,700
124	7 x 7	6	1-3-6	20.1	2.40	13,200	.171	20,400
14	7 x 7	8	1-1½-3	....	2.65	33,000	1.420	[illegible],700
110	7 x 7	8	1-1½-3	20.4	1.97	39,200	2.480	
13	7 x 7	10	1-1½-3	22.8	2.11	39,200	2.480	

Section No. 16. Concrete, 1:1½:3 mix; 6 [illegible] subgrade. This slab resisted 500 blows begin[illegible] drop and 500 blows beginning at ½ in. It failed under the ⅞-in. blows, the first crack developing soon after the 100th blow, at that height with the center settling rapidly under the following 239 blows. The resistance is indicated as being between 23,700 and 26,700 lb. Settlement of 1 in. occurred after 1,160 blows.

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*Only Table 1-A is reproduced here. The others will appear in their proper places, as determined by the text, in later installments.—Ed.

**As in the case of the tables, only one of these is shown here. The others will be included in their proper places.—Ed.

Section No. 112. Concrete, 1:1½:3 mix, 6 in. thick, on dry subgrade. This slab resisted 500 blows beginning at ⅛-in. drop, 500 blows beginning at ½-in., and failed under the ⅞-in. blows with the first crack developing at the 1,175th blow followed by a second crack and resulting in the condition shown in the photograph, Fig. 12, after the 1,414th blow. The indicated resistance lies between 21,600 and 26,700 lb. Settlement of 1 in. occurred after 1,300 blows. The curves show that during the first 1,000 blows settlement was greater for No. 16, but that after cracks developed the settlement was greater for No. 112. It is of interest to note that after the principal cracks developed the resulting blocks resisted the blows without additional breaking. No. 16 can be considered as having shown slightly greater resistance than No. 112 ;first, because it received blows of greater force during the second 500 drops than No. 112 and also because it broke into but three instead of four pieces. It will be noted in Table 1-A, that the moisture content was greater in the subgrade of No. 16, while, contrary to what might be supposed, the supporting power is also indicated as being somewhat better than that of the subgrade under No. 112. It is again indicated that other things being equal the resistance of a road surface is dependent upon the support offered by the subgrade.

Section No. 15. Concrete, 1:1½:3 mix, 6 in. thick, on a wet subgrade. This slab, which was 14 instead of 7 ft. square, was used for the first calibration of the impact machine. It resisted drops of from 0 to 3½ in. at a time when the subgrade was apparently frozen. The first crack, however, was noticed after a 3-in. drop, when the frost was coming out of the ground. The force corresponding to this 3-in. drop is 41,400 lb. When the first cross crack occurred a second developed at right angles to it, followed by two diagonal cracks and then by punching out of the center. The final condition is shown in the photograph.

Section No. 111. Concrete, 1:1½:3 mix, 6 in. thick, on a dry subgrade. This slab, which also was 14 ft. square, resisted 6,000 blows, 500 of which were at ⅛-in. drop, 500 at ½-in., 500 at ⅞-in., 500 at 1¼-in, 500 at 1⅝-in., 500 at 2-in., and 3,000 at 2⅜-in. Its indicated resistance would be 38,900 lb. A second test was made on this slab delivering the blow on a diagonal halfway between the center and the corner of the slab. At this point the slab resisted 500 blows beginning at ⅛-in., 500 at ½-in., and 500 at ⅞-in., failure occurring during the 1¼-in. drops. The indicated resistance was between 28,000 and 31,300 lb., while a settlement of 1 in. occurred after 1,810 blows. The photograph, Fig. 12, shows the condition resulting after 2,150 blows. A third test was made by delivering blows on the extreme corner of the slab. At this point the slab resisted 500 blows at ⅛ in., 500 at ½ in., and failure resulted during the ⅞-in.drops. The indicated resistance was between 23,900 and 26,700 lb., with a 1-in. settlement after 1,260 blows. The photograph shows the condition after this settlement. This failure consisted of a break across the corner. While it it impossible to compare the two 14-ft. sections, it can be seen that they offered considerably greater resistance than the 7-ft. sections. It was also indicated that the larger sections offered more resistance to blows delivered at their quarter points than the 7-ft. sections at the center, while to blows delivered at the extreme corner the 14-ft. sections shows about the same resistance as the 7-ft. sections at their center.

Section No. 124. Concrete, 1:3:6 mix, 6 in. thick, on a dry subgrade. This slab resisted 500 blows at ⅛ in. and failed under ½-in. blows. The indicated resistance was between 13,200 and 20,400 lb. The slab received a total of 734 blows. It will be noted that this slab showed considerably less resistance than the 1:1½:3 specimens.

Section No. 19. Concrete, 1:3:6 mix, 6 in. thick, on wet subgrade. This slab resisted 500 blows at ⅛ in., 500 blows at ½ in., and failed under ⅞-in. blows. One of the photographs

(Continued on page 282)

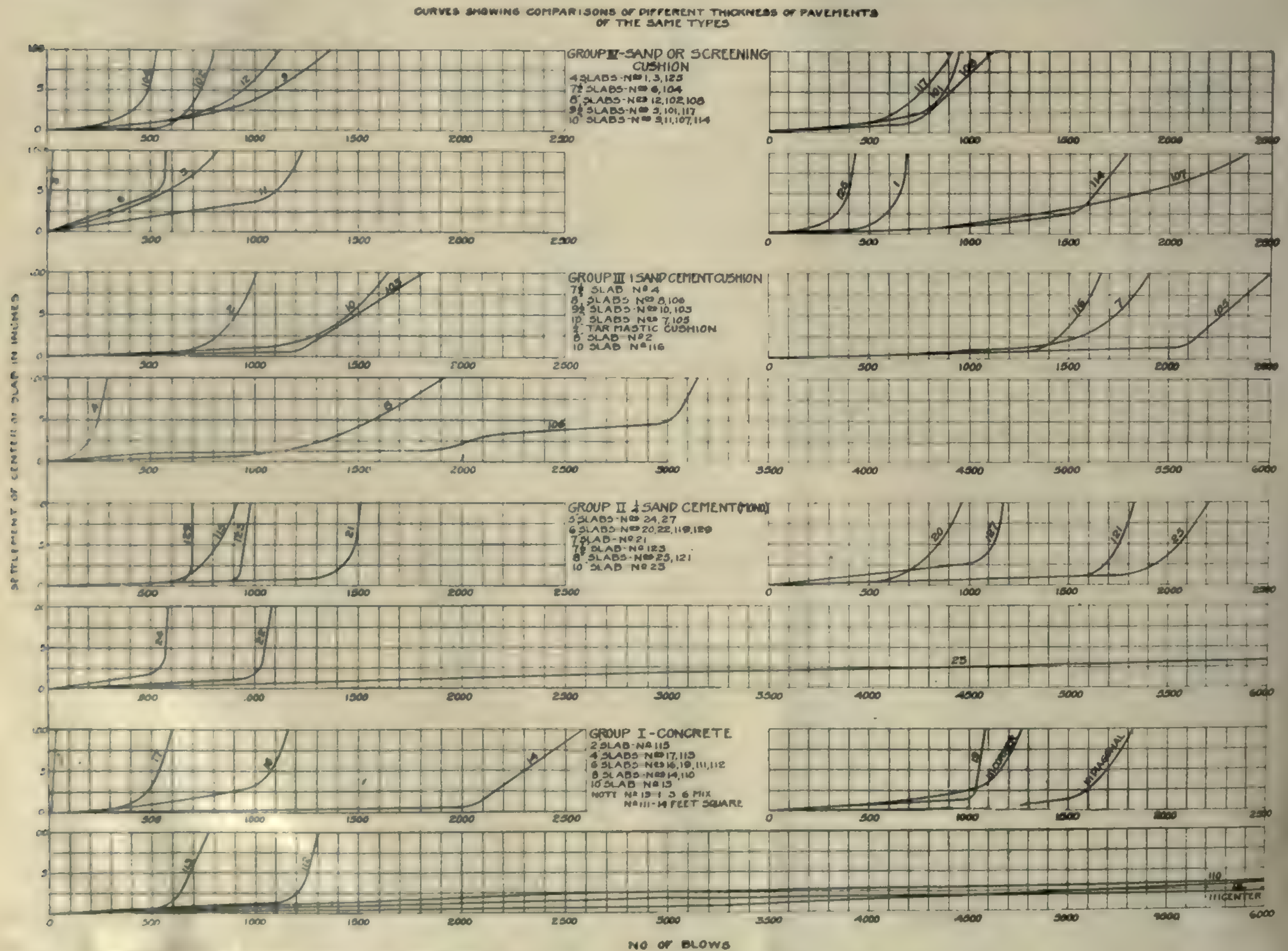

FIG. 17.—CENTER SETTLEMENT CURVES FOR ALL SLABS.

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

Founded January, 1892

E. L. POWERS
Editor

T. A. HULBERT
Managing Editor

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Copy for advertisements must reach the New York office by noon on Tuesday of the week before date of issue if proofs are to be submitted.

Copy for classified and other advertisements where proofs are not required will be accepted until noon on Monday of the week of issue.

Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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Vol. LXI. December 21, 1921 No. 25

THE CONVENTION AT CHICAGO

Within the next month the American Road Builders' Association will hold its nineteenth annual convention and its thirteenth good roads show. At this writing the plans for the meeting have been practically completed and the exhibits arranged for indicate a show greater than any of the preceding ones.

Nineteen years ago when the American Road Makers' Association—as the organization was called originally—was formed, a gathering like that to be held at Chicago next month would have been an impossibility. Though even then there was great popular interest in road improvement, it was far less intelligent and widespread than it is now and the importance of road building as a branch of engineering was not appreciated as it is today.

The most powerful factor in the developments of the past two decades has been the motor vehicle, of course. Not only have the passenger car and the motor truck brought new problems in the technic of construction and maintenance and in economics, but they have, in a measure, brought the means of solving these problems by fostering the devising of new machinery and the utilization of improved methods and materials. They have also, by their demands upon the highway system of the country, forced an appreciation of the necessity of treating road improvement as a business proposition.

Because of the changed attitude of the public and of the road builders themselves, it is possible today to bring together at a national convention several thousand men whose interest in road work is real and practical, who are vitally concerned with the problems of highway construction and maintenance, and who control the highway work of towns and cities, counties, states, and the nation. Twenty years ago such meetings as were held were attended chiefly by laymen, and their mission was principally to persuade the authorities to build roads and the public to provide the necessary funds.

The existing conditions also make possible the assembling of exhibits such as those shown at Chicago a year ago and those to be displayed there next month. These displays render a twofold service, for they enable manufacturers and dealers to get their products before the buyers and they make it possible for the engineer, the contractor and the official to inspect and compare the maximum amount and variety of equipment with the minimum expenditure of time and effort.

In the past the A. R. B. A. conventions and shows have afforded road builders unparalleled opportunities to take advantage of all the facilities afforded by great gatherings of road builders and varied and extensive displays of equipment and materials. The indications are that the coming meeting and show will be even more successful than the very successful meetings and shows of previous years.

Winter Quarters for Machinery "Road officials should make every effort to get all road equipment which is not in use under shelter for the winter. More damage is ordinarily done to graders, tractors and other road machinery by standing out through the winter entirely unprotected than by the actual usage during the road building season." This good advice is from a recent number of the "Service Bulletin" of the Iowa State Highway Commission, and it deserves the widest possible publicity. There are probably no statistics on the waste through leaving road equipment unprotected from the weather for weeks and months, but anyone who is at all observing must have come to the conclusion that the total, if obtainable, would be startling.

Street Work in Canton, China Within the past two years the City of Canton, China, has increased its mileage of streets passable for motor vehicles by 150%. Since this has been done by building only 9 mi. of modern streets, it may not seem like a particularly noteworthy achievement. On the other hand, when one reads that the performance of the work necessitated the razing of 5,000 houses, 15 city gates and 6.5 mi. of old city wall, besides the filling of 1,300 ft. of canal, the undertaking assumes quite a different aspect.

War Material Distribution Some idea of the extent to which the surplus war materials turned over by the War Department to the Department of Agriculture for distribution to the states are being used can be gained from the statement that the approximate value of the materials delivered to the several states up to July 1 was over $117,000,000. The largest allotment went to Texas, which, up to that date, had received materials to the value of over $7,000,000. The next largest allotment was of materials to a value of a little over $5,500,000 to New York State.

Tests of Impact on Pavements by Bureau of Public Roads

(Continued from page 280)

shows the result after the 1,073d blow. The indicated resistance lies between 21,900 and 26,700 lb. Settlement of 1 in. occurred after 1,080 blows. It will be noted that radial cracks have developed in this section, which as a rule are preliminary to punching out of the center. This condition would indicate less resistance to impact than one in which only three or four blocks were formed; but in other respects this slab seems to be the equal of No. 112, the 6-in. slab of 1:1½:3 concrete.

Section No. 14. Concrete, 1:1½:3 mix, 8 in. thick, on wet subgrade. This slab resisted 500 blows at ⅛ in., 500 blows at ½ in., 500 blows at ⅞ in., 500 blows at 1¼ in., developing one crack under the 1⅝-in. blows, which was first observed after 2,050 blows. Five hundred blows following the first crack failed to produce a second. Settlement of 1 in. occurred after 2,580 blows. The indicated resistance would lie between 33,000 and 34,700 lb.

Section No. 110. Concrete, 1:1½:3 mix, 8 in. thick, on dry subgrade. This slab resisted 6,000 blows without any cracks; 500 at each of the drops of ⅛, ½, ⅞, 1¼, 1⅝, and 2 in. and 3,000 at the 2⅜-in. drop. The indicated resistance at this drop would be 39,200 lb. It can be seen from Table 1-A that the penetration of the subgrade around section No. 14 was 2.65 in. and that around section No. 110 was 1.97 in., thus indicating that the latter received much better support than the former. To this better support can be attributed the fact that the latter failed to develop cracks under the same drops which caused them in the former.

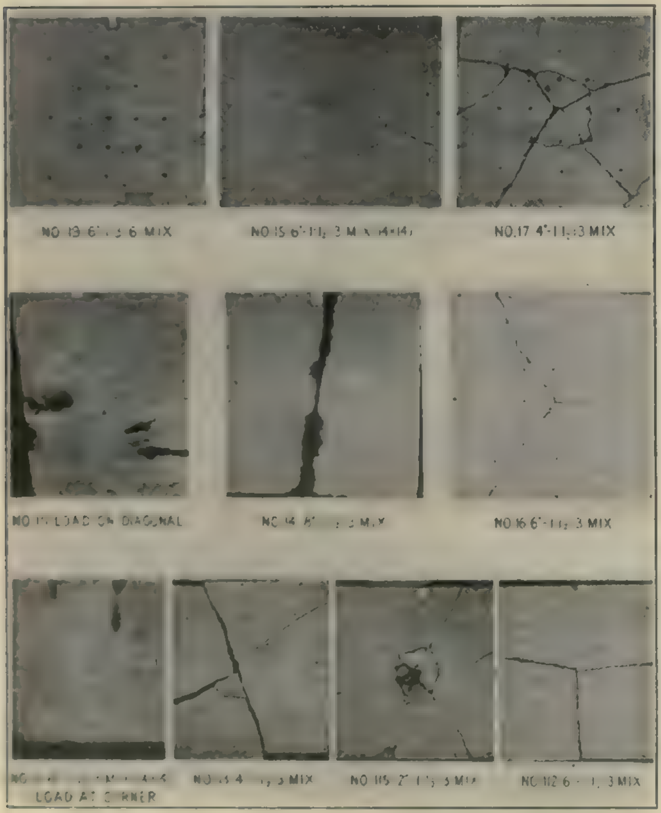

FIG. 12.—CONCRETE PAVEMENT SECTIONS.

Section No. 13. Concrete, 1:1½:3 mix, 10 in. thick, on wet subgrade. This slab resisted 6,000 blows with no sign of failure. The highest indicated resistance was 39,200 lb.

Section No. 109. Concrete, 1:1½:3 mix, 10 in. thick, on dry subgrade. This slab was not tested.

Summary of the Tests of Concrete Slabs

The tests of the concrete sections show that slabs of 2-in. thickness are impractical for road surfaces and that slabs 4 in. in thickness can barely resist the static load of the heavier trucks without cracking, so that they surely would fail under impact of such trucks. It is indicated that the 6-in. types are good for a resistance of 21,000 to 24,000 lb. while the 8-in. are good for about 34,000 lb. on subgrades of no less supporting power than those of the test slabs. The indicated resistances of the slabs are 2-in., 7,800; 4-in., 14,000; 6-in., 24,000; 8-in., 34,000; and 10-in., something over 40,000 lb. It is shown that in all cases the slab resistance is dependent upon the support offered by the subgrade. Another indication seems to be that the resistance is overcome by the magnitude rather than the repetition of the blows. Considerable variation was shown between the two 6-in. 1:3:6 slabs, but the low resistance shown by No. 124 and the radial cracks which formed in No. 19 seem to indicate that they are not as strong as the 1:1½:3 specimens.

(To be continued)

DISTRIBUTION OF FEDERAL AID FUNDS

New Federal Aid Road Bill Making Available a Total of $75,000,000 for Federal Aid Roads and $15,000,000 for Forest Roads Will Yield States Sums Ranging from $365,625 to $4,425,172.41

The new federal aid road bill, as noted in previous issues, carries an appropriation of $75,000,000 for aid to the several states in the construction of main roads and an additional $15,000,000 for the building of roads in the national forests.

The $75,000,000 appropriated is for the fiscal year ending June 30, 1922, and $25,000,000 of it is immediately available, the balance becoming available on January 1, next. Of the forest road appropriation, $5,000,000 is available for the fiscal year ending June 30, 1922, and the remaining $10,000,000 is available for the following year.

The apportionment of the $75,000,000 to the several states is shown in the accompanying table. The minimum allotment, $365,625, goes to each of four states, Delaware, New Hampshire, Rhode Island and Vermont. The largest goes to Texas which will receive the sum of $4,425,172.41. The states that will receive amounts between $3,000,000 and $4,000,00 are Pennsylvania, New York and Illinois, while seven states will have amounts between $2,000,000 and $3,000,000.

The following summary of the terms of the new law is from a statement issued by the Department of Agriculture:

"The Federal Highway Act in a general way resembles the Federal Aid Act of 1916, but contains several new features. Administration of the act by the Secretary of Agriculture, and under him the Bureau of Public Roads, remains unchanged.

"Apportionment of the fund to the states is almost the same as under the previous act, the fund being divided into three parts—one part apportioned according to population, one according to area, and one part according to mileage of rural and star mail routes. A new feature is the stipulation that no state shall receive less than one-half of 1% of the total fund, which, in this case, amounts to $365,625. This stipulation will increase the amount received by four of the smaller states, *i.e.*, Delaware, New Hampshire, Rhode Island and Vermont.

"There is considerable change, however, in the manner in which a state may use its allotment. Each state must select a connected road system not exceeding 7% of its road mileage for improvement with federal aid. This system will be divided into two classes, one of which will be known as interstate highways and the other as intercounty highways. The interstate highways must not exceed three-sevenths of the system selected; on them not more than 60% of the state's allotment can be spent without the joint approval of the Secretary of Agriculture and the state highway department. The intercounty highways, which consist of the remainder of the system selected, will receive the remainder of the state's allotment.

"Except in states where more than 5% of the area is unappropriated public land, the amount of federal aid received on any project must not exceed 50% of the estimated cost. In states where more than 5% of the area is unappropriated public land, the 50% allotment is increased by an amount equal to one-half of the percentage of unappropriated public land in the state. Before any funds can be paid to a state, the state must appropriate money, under the direct control of the state highway department, to match the federal allotment and for the maintenance of federal aid highways.

"All highways in the interstate system must have a surfaced width of at least 18 ft., unless a narrower width is deemed permissible by the Secretary of Agriculture. In case a federal aid highway is not properly maintained by a state, the state will be given 90 days' notice by the department; at the end of that time, if the highway is not in good condition of maintenance, the Secretary of Agriculture will maintain it out of the state's allotment and refuse to approve any new projects until reimbursement is made by the state."

ALLOTMENT OF FEDERAL AID FUNDS TO STATES

State	Amount	State	Amount	State	Amount
Alabama	$1,553,420.67	Maine	$695,160.25	Ohio	$2,823,004.05
Arizona	1,053,281.44	Maryland	640,629.01	Oklahoma	1,752,339.44
Arkansas	1,254,142.20	Massachusetts	1,096,176,04	Oregon	1,182,663.90
California	2,462,098.53	Michigan	2,249,532.43	Pennsylvania	3,398,953.97
Colorado	1,341,175.69	Minnesota	2,123,597.07	Rhode Island	365,625.00
Connecticut	480,897.78	Mississippi	1,294,906.22	South Carolina	1,061,237.34
Delaware	365,625.00	Missouri	2,448,128.62	South Dakota	1,204,060.31
Florida	886.825.69	Montana	1,546,885.82	Tennessee	1,647.692.24
Georgia	1,997,957.58	Nebraska	1,581,189.50	Texas	4,425,172.41
Idaho	938,536.68	Nevada	953,436.78	Utah	849,417.21
Illinois	3,246,281.07	New Hampshire	365,625.00	Vermont	365.625.00
Indiana	1,958 855.41	New Jersey	942,870.95	Virginia	1,456.828.47
Iowa	2,102.872.74	New Mexico	1,189,823.34	Washington	1,103,709.77
Kansas	2,102,281.51	New York	3,696,447.97	West Virginia	802.359.77
Kentucky	1.417,178.68	North Carolina	1,709,333.90	Wisconsin	1,894,815.86
Louisiana	996,989.64	North Dakota	1,164,714.42	Wyoming	934,617.63

MOTOR TRUCK OVER-LOADNG

National Automobile Chamber of Commerce Adopts Resolutions Condemning the Practice of Over-Loading and Over-Speeding

Resolutions reaffirming its policy of "being unalterably opposed to over-loading and over-speeding of motor vehicles" were passed at a recent meeting of the National Automobile Chamber of Commerce.

After pointing out that certain states have passed laws permitting the registration of motor vehicles with a carrying capacity in excess of the manufacturer's rating upon the production of a certificate from such manufacturer that the vehicle can be "safely operated" and "under all conditions" and "at all times," the resolution continues:

"It is the conclusion of the National Automobile Chamber of Commerce that the giving of such certificates authorizing the carrying of loads in excess of the rated carrying capacity of such motor vehicles under the conditions of such laws is dangerous because of, first, contingent liability on the manufacturer in case of accident, both personal liability and property damage; second, claims under the manufacturer's warranty for breakage and defects resulting from over-loading authorized by such certificates; third, for the far more important reason that the acquiescence of motor vehicle manufacturers to over-loading will be immediately seized upon by legislators as a basis for further restrictive legislation and higher license fees, and will immediately deprive the manufacturers of the co-operation of the Bureau of Public Roads of the Department of Agriculture, the state highway commissioners, and public road officials in their attempt to reach a practical solution of the highway problem in its relation to motor vehicle transportation; and fourth, the granting of certificates by manufacturers permitting over-loading violates not only every engineering and manufacturing principle, but every principle of clean, competitive selling, and can only result in misunderstandings and sales resistance, as having once departed from a national understanding and enforcement of the manufacturer's rated carrying capacity, there is no limit on over-loading that can be accepted as a standard."

MEETINGS

Calendar of Coming Meetings

Dec. 22-23—Kansas Engineering Society.—Annual Meeting, Hutchinson, Kan. Secretary, J. M. Averill, Topeka, Kan.

Jan. 5-6—Federated American Engineering Societies.—Annual Meeting, Washington, D. C.

Jan. 17-19—Iowa Engineering Society.—Thirty-fourth Annual Meeting, Sioux City, Iowa. Secretary, L. A. Canfield, Des Moines, Ia.

Jan. 17-19—Associated General Contractors of America—Third Annual Meeting, Hotel Winton, Cleveland, Ohio. General Manager, R. C. Marshall, Jr., 1038 Munsey Bldg., Washington, D. C.

Jan. 17-20, 1922.—American Road Builders' Association.—Nineteenth Annual Convention, Twelfth Americal Good Roads Congress and Thirteenth Good Roads Show under the auspices of the A. R. B. A., The Coliseum, Chicago, Ill. Secretary, E. L. Powers, 11 Waverly Place, New York, N. Y.

Feb. 12-17—Conference on Highway Engineering.—Eighth Annual Conference, University of Michigan, Ann Arbor, Mich.

AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICALS

The annual meeting of the American Association of State Highway Officials was held at Omaha, Neb., on Dec. 5, 6, 7 and 8. Considerable attention was given to the subjects of economics of location, tests of concrete slabs, federal aid policies, and traffic, and a wide range of related topics also received attention.

Among those who spoke upon the economics of location were State Highway Commissioner Bennett of Connecticut, State Highway Commissioner Rogers of Michigan, State Superintendent of Highways Sheets of Illinois, State Highway Engineer Windrow of Texas, Commissioner Crawford of Indiana, Chief Engineer White of the Iowa Highway Commission and Chief Engineer Hirst of the Wisconsin Commission. All of the speakers emphasized the importance of proper location in the first instance. Attention was also directed to the great effect of location upon transportation and its cost.

A. T. Goldbeck, Chief of the Division of Tests of the Bureau of Public Roads, presented a paper describing and analyzing the effects of temperature upon concrete slabs. Chief Engineer Hirst of Wisconsin presented a paper entitled, "Safety and Beauty as Factors in Road Design and Construction."

A particularly interesting paper, "Resume of Cooperative Road Improvement and Future Policies," was presented by Chief Thomas H. MacDonald of the Bureau of Public Roads. New developments in the technic of road building during the past year were discussed in a paper presented by State Highway Engineer Upham of North Carolina, and a discussion of road building equipment was presented by B. H. Piepmeier, Engineer of Construction of the Illinois Division of Highways. Maintenance was covered by W. A. Van Duzer, Assistant Maintenance Engineer of the Pennsylvania State Highway Department.

Resolutions were unanimously adopted by the convention as follows:

BE IT RESOLVED, That this Association expresses its hearty appreciation of the many courtesies rendered the Association by the management of the Hotel Fontenelle, and by the Mayor and citizens of Omaha, and that the Association especially expresses its gratitude to certain members of the Nebraska State Road Association and to Mr. George E. Johnson of Nebraska for the splendid entertainment provided for the membership while in Omaha.

BE IT RESOLVED, That this Association expresses its hearty appreciation to the members of the Executive and Legislative Committee, and to Mr. W. C. Markham, for their successful guardianship of the principles of friendly co-operation between the Federal Government and the states in the upbuilding of our highways, as opposed to the too centralized federal control proposed in other measures before the Congress.

Their successful efforts to preserve and extend this principle is more than a temporary success. It has resulted in the adoption by Congress of a permanent policy of federal aid.

BE IT RESOLVED, That the American Association of State Highway Officials welcomes the establishment by the National Research Council of the Advisory Board on Highway Research and that the Association peldges its support to the Advisory Board in this much needed effort to stimulate and coordinate highway research.

We wish to extend to the State of Illinois and to the Federal Bureau of Roads our appreciation of their experiments and enlightening reports on highway design. We hope there will be available before our next annual meeting a comprehensive report of the results of the noteworthy experiment at Pittsburg, California.

WHEREAS, It has come to the attention of this Association that "Public Roads," the monthly magazine of the Bureau of Public Roads, has been indefinitey suspended ,together with other government periodicals, and

WHEREAS, "Public Roads" is a necessary medium to disseminate the results of highway research and for the interchange of opinions and ideas between the Federal Department of Agriculture and the highway departments of the several states in connection with the administration of cooperative highway construction under the Federal Highway Act,

NOW, THEREFORE, BE IT RESOLVED, That the American Association of State Highway Officials endorses "Public Roads" as heretofore issued, and urges that its publication be immediately resumed.

WHEREAS, Advertising signs upon, along or adjacent to public highways serve no good purpose, but, on the contrary, are a public nuisance in that they destroy the beauty of our landscapes, impair vision in dangerous places, and add to the difficulty of properly guiding and warning traffic, BE IT, THEREFORE, RESOLVED, That this Association pledges its support to any proper movement to eliminate such advertising signs and urges upon its individual members the importance of aiding and encouraging legislation in all states to effect said elimination, to the end that our highways may be fully and safely occupied and enjoyed by the public, for the use of whom they are acquired and built.

WHEREAS, Grade crossings of railroad and interurban lines with our highways constitute a grave menace to human life and property, and

WHEREAS, The increasing travel on our highways is each year making the danger greater and the list of dead and injured longer,

BE IT, THEREFORE, RESOLVED, That this Association pledges itself collectively and as individuals to use its best efforts to speed up the properly planned elimination of grade crossings, to the end that all of them, especially on the main traveled highways, shall be eliminated as rapidly as funds can be made available by the public and the railway companies.

BE IT FURTHER RESOLVED, That we condemn, as against public policy, the present attitude of negation adopted by too many railroad companies and by too many state railroad commissions, because such attitude has resulted in the slackening of elimination work at a time when the protection of the traveling public is much more urgent than ever before.

BE IT RESOLVED, That the American Association of State Highway Officials heartily endorses the action of Congress in adopting a policy of federal aid for highways to be applied to a definite system of highways as provided in the Federal Highway Act which went into effect November 9, 1921.

As officials of the state highway departments upon whom this law imposes certain requirements and obligations, we pledge our hearty and unqualified support to the Federal Bureau of Public Roads in carrying out the provisions of said act.

Inasmuch as the act contemplates continued federal participation with the states in highway improvement, we realize and emphasize the absolute necessity of a definite policy projected far enough into the future to make possible the economic and satisfactory planning and carrying out of the intent and purpose of the act.

To this end we endorse H. R. 8978, introduced by the Hon. Roy Woodruff, which bill authorizes the appropriation of $100,000,000 annually for five years beginning July 1, 1922, as a general federal aid appropriation, and we also urge that adequate provision be made in the said bill for the continued development of highways in and adjacent to the forest areas and Indian reservations under unified control.

The adoption of this five-year program is necessary to enable the states, through their legislatures, to make proper provisions for the requisite state cooperation in this enterprise.

WHEREAS, There are many inequalities existing in the present freight rates on road materials, and

WHEREAS, Road materials have been and are in many cases discriminated against as compared with the treatment accorded other commodities, and

WHEREAS, The highway work of the states and the Federal Government should not be required to pay more than its fair share of the cost of keeping up our system of railroad transportation,

BE IT, THEREFORE, RESOLVED, That the American Association of State Highway Officials urges upon the Interstate Commerce Commission and upon the various state railroad commissions (or equivalent state bodies) the importance of a review and comparison of the present rates on road materials and other commodities, to the end that present existing inequities may be removed and the taxpayers' interests protected.

WHEREAS, The Congress has made available certain motor trucks and other equipment and materials valuable in road building, declared surplus war material by the War Department, and

WHEREAS, Certain business interests have declared that the equipment and materials thus made available for the public use have been generally mismanaged and illegally disposed of by the states, and

WHEREAS, Such statements are prejudiced and an unfair reflection upon all state highway departments and are unjustified and untrue,

NOW, THEREFORE, BE IT RESOLVED, That the American Association of State Highway Officials assures the President and the Congress that said materials and equipment have been of incalculable service to the states in the prosecution of their program of highway construction and maintenance and that they have been used for these purposes and no other, with a resultant saving of untold millions of dollars to the American people, and

BE IT FURTHER RESOLVED, That we urgently request the further distribution to the states of such other surplus war materials as may be available, especially of 5 and 10-ton caterpillar tractors, which are necessary and valuable in the prosecution of modern highway programs. We so urge because we believe that in no other manner can the American people secure so large a salvage value from said materials and equipment. We invite comparison between the yield to the American people from the material so far distributed to the states, as compared to the yield from that so far sold by the War Department.

WHEREAS, By far the greater portion of the cost of modern highway construction and maintenance is due to the necessity of adequately providing for the movement of persons and goods by motor vehicles, and

WHEREAS, The taxes imposed upon real and personal property have, in many states, reached almost the maximum possible to be borne under present economic conditions, and

WHEREAS, The principal users of our highways, the operators of motor vehicles, can be justly charged an adequate amount for benefits derived and savings secured from and by our programs of highway construction and maintenance, and

WHEREAS, In most of our states the owners of motor vehicles are paying an insufficient portion of the cost of the state's highway program, as compared to the portion of the cost raised by taxation on general property, despite the fact that the individual owner is always willing to pay his fair share of such cost

NOW, THEREFORE, BE IT RESOLVED, By the American Association of State Highway Officials that we urge upon all states the fairness and necessity of collecting an adequate portion of the cost of highway programs from the users of motor vehicles. This fair share is not only the cost of maintenance of modern highways, but includes also a fair proportion of the cost of new construction, because much of this latter cost is due to the necessity of adequately providing for motor traffic.

BE IT FURTHER RESOLVED, That we recommend appeals to the individual motorist for his support of this policy of providing for a fair dstribution of the cost of highway improvement, because we believe that when he is made to realize that only in this way can a continuance of the required highway programs be guaranteed to him, he will, being a fair minded American citizen, readily respond to such appeals.

WHEREAS, The American people have embarked upon programs of highway improvement involving the expenditure of many billions of dollars in the next decade, and

WHEREAS, The effective expenditure of these billions of dollars, and the proper carrying out of these programs, depend upon the abilty and efficiency of the federal and state highway departments, and

WHEREAS, The American people have not so far appreciated the magnitude of this enterprise or the necessity of permanent and efficient organizations to carry it on, and

WHEREAS, If our people are not soon brought to a realization of these facts, disaster is bound to follow, bringing grave loss to them and reflecting discredit upon all engaged in this enterprise,

BE IT, THEREFORE, RESOLVED, That this organization pledges itself to work for efficiency and permanency in the personnel of all departments engaged in this enterprise, for the elimination of partisan politics from the operation, and for the reward of ability wherever found.

BE IT FURTHER RESOLVED, That each individual member who is a believer in the dignity and importance of this work shall do everything in his power to sell the idea of clean cut business efficiency in highway operations to his legislative body and to his people.

Officers for the coming year were elected as follows: President, C. M. Babcock, State Highway Commissioner of Minnesota; Vice President, C. J. Bennett, State Highway Commissioner of Connecticut; Secretary, C. M. Upham, State Highway Engineer of North Carolina; Treasurer, F. T. Sheets, State Superintendent of Highways of Illinois. W. D. Uhler, Chief Engineer of the Pennsylvania State Highway Department, and D. P. Olson, Director of the Idaho Bureau of Highways, were elected to the Executive Committee, their terms expiring in 1926.

NATIONAL PAVING BRICK MANUFACTURERS' ASSOCIATION

The annual conference of the National Paving Brick Manufacturers' Association was held at Pittsburgh, Pa., on Dec. 6 and 7.

The chief business of the meeting was the reception of reports of officers and committees. Several papers were presented also, among the speakers being Arthur H. Blanchard, Professor of Highway Engineering and Highway Transport at the University of Michigan, and A. V. Bleininger, Chairman of the Joint Clay Products Research Committee.

The meeting heartily endorsed the work of the recent conference under the auspices of the Department of Commerce, at which the varieties of standard paving bricks were reduced in number from 66 to 11.

AMERICAN CONCRETE INSTITUTE

The annual meeting of the American Concrete Institute will be held in Cleveland, Ohio, on Feb. 13, 14, 15 and 16, 1922.

Present plans are to have nine sessions, two on each of the first three days and three on the last day. Two sessions will be devoted to the consideration of contractors' problems; two for the manufacturers of concrete products; one on roads, and one each on houses and research, and two on engineering design and inspection.

PERSONAL MENTION

P. J. O. Smith has been appointed superintendent of streets of Spartanburg, S. C.

C. D. Buck has been appointed chief engineer of the Delaware State Highway Commission, effective Jan. 1, 1922. He was formerly assistant to the chief engineer.

Alfred A. Taylor has been appointed street cleaning commissioner of New York, N. Y. His appointment as acting commissioner upon the resignation of John P. Leo was recently noted in this column.

James M. Owens, formerly a highway engineer in the office of the city engineer of San Francisco, Cal., has left for Honolulu where he is to serve that city as a consulting engineer on paving work.

Maj. Thomas M. Robins, Corps of Engineers, U. S. Army, has been appointed to membership on the board of officers that will study the matter of a national highway system in connection with rural post road construction.

W. G. Thompson, formerly State Highway Engineer of New Jersey, has resigned his position with the Lakewood Engineering Co., of Cleveland, Ohio. He will continue to act as consulting engineer for the Lincoln Highway Association.

PROGRESS OF STREET IMPROVEMENT IN THE CITY OF CANTON, CHINA

The City of Canton, China, has made considrable progress in street work during the past two years, according to Vice Consul Ernest B. Price, in a recent issue of the "Commerce Reports."

On Jan. 1, 1920, Canton had only 6 mi. of streets suitable for motor car traffic. None of this mileage was in the city proper, but was along the river front and in the eastern suburbs. The main part of the city, in which there are nearly a million people, had no streets suitable for wheeled traffic, according to Mr. Price.

By July 1 of this year, however, the city had completed, except for the final surfacing, 9 mi. more of modern streets, varying in width from 80 to 150 ft. These streets are in the heart of the city, and sewers have been laid throughout their entire length. In addition, there were 7.5 mi. under construction and it was expected that they would be completed by the end of the year. The new streets are surfaced with cement concrete which is laid on a foundation of crushed brick and stone.

The construction of the new streets necessitate the razing of some 5,000 houses, 15 city gates and 6.5 mi. of old city walls, and the filling of 1,300 ft. of old can.

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Old Asphalt Paving Material in Maintenance*

Experience of the City of Milwaukee in the Use of Old Asphaltic Paving Material in Street Maintenance—Methods and Costs—Volume of Work Done

By C. J. VAN ETTA†

In presenting this paper I do so with the hope that it will be of value to those who have to do with the repair of asphalt streets. Having had nine years' experience with the handling of this old material, and after considerable experimenting, I feel that we have reached the point of perfection in its handling, and I sincerely hope that others will profit by our experience.

Since the year 1912 we have been using this old material for the repair of asphalt streets and have been entirely successful, both as to cost and wearing quality of the mixture. When I first took up this work, our methods were somewhat crude because of my inability to procure a machine suitable for handling the old material. We started with a very small hot mixer, which could not produce more than 50 or 60 sq. yd. of 3-in. thickness a day. Our costs ran high, owing to the small amount of yardage that we were able to produce.

After the first season I came to the conclusion that there was a great value attached to this old material, and if the proper equipment could be had to handle it in larger quantities, I was satisfied that we would be able to take care of our repair of asphalt streets with the use of the old material at a very small yardage cost. We designed a machine at that time which was able to produce about 25,000 sq. yd. for the season—about six months' work. I became so interested in the discovery of the use of this old material that I set about to increase the capacity of the plant still more, with the result that for the past five or six years we have been able to produce something like an average of 60,000 sq. yd. of 3-in. material a season. We are at present using a plant built by the Warren Brothers Co., which was a portable plant, and is giving excellent satisfaction. It was intended at first to use this plant to be pulled about the city but instead of using it as a portable plant I had it placed on a concrete foundation to make it stationary, and our trucks haul the reclaimed material to the job on the street. I found that this was the better plan because it was necessary to make some changes in the plant which would have been impossible had we used it as a portable mixer. The result is that we are now producing from 300 to 700 sq. yd. per day. The biggest day's run that we had from this plant with the old material in 1921, was 24 (2½-cu. yd.) loads. We figure about 30 surface yards to the load, or about 225 lb. to the square yard. The average daily cost of the plant, which includes common labor, engineer, fireman, foreman and truck drivers, fuel oil and other incidentals which go into the operation of the plant, is about 35 ct. per square yard. The street cost, which includes the tearing up, trimming joints and other work necessary to prepare the street for the new material, and the hauling away of the old material, is about 30 ct. per square yard. We use at the plant a force of 22 common laborers at 65 ct. per hour, 8 hours a day, an engineer at $1.05 per hour, a fireman at 80 ct. per hour, and truck driver at $7.20 per day—an average payroll of about $150 per day, which includes, as I have heretofore mentioned, fuel and other incidentals. There is also one team at $8.00 a day to be added to our force at the plant.

There is no set rule as to the amount of new material, that is A. C., that is used, but we figure on an average of about 15 to 20%. We have an organization which handles this material at the plant, who have been with me for the past eight or nine years and are thoroughly experienced in the handling of this mixture to the extent that they have only to look at the old material to judge about the amount of A. C. necessary to improve the mix.

The wearing quality of this old reheated mixture is really surprising. I have brought samples with me that were made last week of the mixed material compressed, which I think, if examined you will find is a wonderful mixture from the standpoint of wearing quality. I have in mind two blocks of street within a block of the City Hall in Milwaukee which were resurfaced with this old material because of some grade changes that were brought about by building a bridge over the river at this point and has been down for the past eight or nine years. This surface was laid just previous to the time the bridge crossing our river on the main street was built. When the work of building this bridge was taken up it shut off the traffic from the street—this traffic being diverted over the street on which this old material was laid and which is an exceptionally busy street. Eighty per cent. of this traffic from the main street was diverted to the street in question, and it consisted of traffic of every description.

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*Paper presented at the 27th annual convention of the American Society for Municipal Improvements, Baltimore, Md., October 25-28, 1921.

†Superintendent of Street Construction and Repair, Department of Public Works, Milwaukee, Wis.

Up to date we have spent practically nothing on the maintenance of these two blocks laid with this old material and I think no better proof of its wearing quality can be had than this particular instance. I have taken a sample from this street which was laid in 1912, which will speak for itself. I think upon examination you will find that there is little or no deterioration in the mixture.

When we let contracts for the resurfacing of asphalt streets with new material, we embody in the contract a clause which compels the contractor to haul all of the old surface mixture, including the binder course, to this central plant. He also provides men to pile it so that there is no cost to the city for this old material.

The old material is broken up with sledges and is put into our mixer and heated to a point where it becomes workable, the binder stone included in the old mixture. It is only, as I have stated before, where new material is necessary and that depending upon the condition of the old material, that we add A. C. The method of breaking up the old material is not the most profitable one, but to date we have been unable to find a crusher that would take care of this old material the year round. Last fall and early this spring we installed a gyratory crusher and crushed a pile of about 500 cu. yd. and found that where it was crushed from ½ in. down to dust we got far better results because of the short time in which we were able to produce a batch and also the quality of the mix, which was far easier and better to work on the street than where it had to remain in the drum for a longer period and this owing to the fact that the material went into the plant in pieces as big as your hand. We also discovered that where we used from 18 to 20 laborers in breaking up the old material at 65 ct. an hour, we would be able to reduce this force to 4 men, which you can readily see would tend to lower the cost considerably. We expect to be able to install a crusher before the coming season that will handle this material the year round. We found that with a gyratory crusher as soon as the weather became warm the mixture would become soft and could not be handled by the crusher. It was only during the cold months of early spring and late fall that we were able to operate this crusher with success.

We are working on a plan, now, and if we are successful in landing the crusher, together with other ideas we have in mind, we will be able to reduce the plant cost to the absolute minimum. We are planning to have in connection with the crusher, a belt conveyor which carries the mixture to our hopper, and which I believe will be the means of facilitating matters in producing a batch. It requires at the present time about 14 minutes to produce a batch of the material where it is of large size, but with these new provisions I figure that we will be able to produce a batch in about 8 minutes.

In 1919 we laid 70,000 sq. yd. at an average cst of 55.5 ct. pe rsquare yard; in 1920 we laid 71,000 sq. yd. at an average cost of 79 ct. per square yard. This difference in cost was due to the increased wage that we paid for this work, which amountel to 80 ct. an hour for common labor, and skilled labor in proportion. In 1921, from January to October, we laid 60,000 sq. yd. at an average cost of 67 ct .per square yard.

There has been considerable discussion at various meetings of road builders relative to the use of this old material, and it has been said that it could not be used under any circumstances; that it had been hauled to the dumps and no effort whatever made to reclaim it. I have in mind a discussion which arose at the 1918 convention, during which it was said that the Barber Asphalt Co. had expended something like $60,000 experimenting with this old material trying to reclaim it. It seems that their method was to unscramble the old mixture, using the sand and other ingredients, but that they had been unsuccessful. It was also said that in Philadelphia there was a concern which had been experimenting for some time but up to that time had found no solution to the problem. Mr. MacCullum, who attended the convention at that time, was credited with the remark that this old material could not be used under any circumstances and that the cities would be money ahead if they paid to give it away. When at New Orleans attending a convention some two or three years ago, I encountered an asphalt repair gang working on one of the main streets. I talked to the foreman and during the course of our conversation asked him what, if any, use was made of the old material taken out of the street. He said that it was hauled to the dumps. I asked if it was not possible to reuse it in some way but he said that it was ridiculous to suppose that the old stuff could be reheated and put back into the street. He also said the cost would be so great that it would not be worth while. It was evident that he had no experience with the handling of this old material and so I closed the conversation.

I received a communiction from the assistant engineer of the City of New Orleans about three weeks ago asking for information as to how we handled the old material in Milwaukee. I wrote him in detail explaining our methods and made suggestions which I felt would be of value to him in starting the work of reclaiming this old material —with the result I am satisfied that he will follow the advice given him as he appeared very anxious to know just what our methods were.

Test of Impact on Pavements by the Bureau of Public Roads

BY C. A. HOGENTOGLER†

(Continued from December 21)

Comparison of Monolithic Brick Sections

The sections in this group have grouted brick surfaces with ¼-in. sand-cement cushions laid on green concrete bases. The combined concrete and brick slabs range in thickness from 5 to 10 in. The center settlement curves are shown in Fig. 17 (see "Good Roads" for Dec. 21.—Ed.), while representative failures appear in Fig. 13. Table 1-B gives the indicated resistances.

Section No. 24. Four-inch wire-cut lug brick, laid on a 1:3:6 base, 1 in. thick, wet subgrade. This slab resisted 500 blows, beginning with ⅛-in., and failed under ½-in. blows. The curve, Fig. 17, shows the settlement after 617 blows. The indicated resistance lies between 16,800 and 20,400 lb.

Section No. 127. Four-inch wire cut lug brick, laid on a 1:3:6 base, 1 in. thick, dry subgrade. This slab was subjected to 1,200 blows. It resisted 1,000 blows, beginning with the ⅛-in. drop. The first crack was observed after 500 blows. Settlement, however, remained uniform through the next 500 blows with rapid breaking up during the last 200. The indicated resistance was 18,300 lb. Table 1-B shows that there is little difference between the moisture content and bearing power of the two subgrades to account for the difference in the behavior of these two slabs of the same construction. It is possible that the difference may have been caused by separation of the base and top in one section before the other. It is also to be remarked that the first crack in No. 127 occurred under a number of repeated blows at approximately the same height of fall rather than after a change in the height of fall. This type of failure, which seems to be common with monolithic construction, can be explained by the fact that up to a certain point the slab acts as a monolith, but after a number of repeated blows the brick is separated from the concrete base, resulting in two slabs, the combined resistance of which is not greater than the sum of resistance of the two parts.

Section No. 22. Four-inch wire cut lug brick, laid on a 1:3:6 base, 2 in. thick, wet subgrade. This slab withstood 500 blows, beginning with ⅛-in. drop, 500 blows, beginning with ½-in., and broke up rapidly under 144 blows, beginning at ⅞-in. The indicated resistance was between 22,300 and 26,700 lb. The views of the top and base (Fig. 13) show the inability of a surface of this thickness to withstand the forces to which it was subjected. This point is clearly brought out by the badly shattered condition of the base.

Section No. 129. Four-inch wire cut lug brick, laid on a 1:3:6 base, 2 in. thick, dry subgrade. This slab resisted 500 blows at ⅛-in. drop and 163 blows at ½-in., after which a badly broken condition resulted with the succeeding 59 blows. The indicated resistance was 20,400 lb. Like No. 22, the base of this slab was also badly shattered. A comparison of the two slabs shows, however, that No. 129 offered less resistance than No. 22. As the possible explanation we find, by reference to Table 1-B, that the bearing power of the subgrade under No. 22 seems to be considerably greater than that of No. 129. In No. 129 we find again that failure occurred because of the separation of the base from the top and the immediate breaking up of the resulting two slabs.

Section No. 20. Three-inch wire cut lug brick laid on a 1:3:6 base, 3 in. thick, wet subgrade. This slab resisted 500 blows at ⅛-in. drop and was badly broken under 520 blows, beginning with ½-in. The indicated resistance lies between 12,000 and 20,400 lb.

Section No. 119. Three-inch wire cut lug brick laid on a 1:3:6 base, 3 in. thick, dry subgrade. This slab resisted 500 blows at ⅛-in. drop and was badly broken under 500 blows, beginning with ½-in. The indicated resistance lies between 12,200 and 20,400 lb. Although the subgrade under No. 119 was better than that under No. 20, there seems to be little difference in the resistance offered by the two slabs. Again, it is evident that instead of acting as a monolith this section simply acted as two independent 3-in. slabs.

Section No. 21. Three-inch wire cut lug brick, laid on a 1:3:6 base, 4 in. thick, wet subgrade. This slab resisted 500 blows at ⅛-in. drop, 500 blows at ½-in., and 250 at ⅞-in., breaking up under 395 additional blows beginning at ⅞-in. The indicated resistance was 26,900 lb. Again, it is noted that failure occurred because of the separation of the two parts of the surface under repeated blows of approximately the same height.

Section No. 118. Three-inch wire cut lug brick, laid on a 1:3:6 base, 4 in. thick, dry subgrade. This slab resisted 500 blows at ⅛-in. and 500 blows at ½-in., failing under the ⅞-in. blows, showing a cracked and settled condition at the end of 442 blows from that height. The indicated resistance lies between 21,400 and 26,700 lb. This slab offered about the same resistance as No. 21 although in this case the top did not separate from the base during the run of 500 blows.

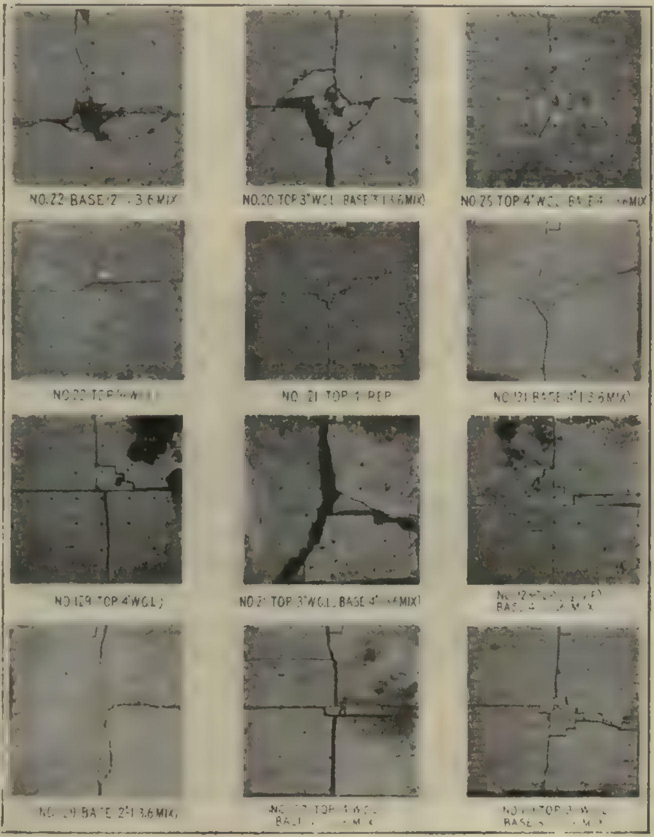

FIG. 13—BRICK TOPS ON CONCRETE BASES WITH 3/16 INCH SAND CEMENT CUSHIONS (MONOLITHIC CONSTRUCTION).

Section No. 123. Three and one-half inch vertical fiber brick, laid on a 1:3:6 base, 4 in. thick, dry subgrade. This slab resisted 500 blows at ⅛-in. drop, 410 blows beginning with ½-in., rapidly breaking up under 149 succeeding blows. The indicated resistance was 21,000 lb. Again, the behavior of the section was characterized by separation of the two parts of the surface under repeated blows followed by rapid failure.

Section No. 25. Four-inch wire cut lug brick, laid on a 1:3:6 base, 4 in. thick, wet subgrade. This slab resisted 500 blows at ⅛-in. drop, 500 blows at ½-in., 500 blows at ⅞-in., 250 blows at 1¼-in., resulting in the condition shown by the

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*From "Public Roads," the official publication of the Bureau of Public Roads, U. S. Department of Agriculture, November, 1921.

†Highway Engineer, Bureau of Public Roads, U. S. Department of Agriculture.

photograph (Fig. 13) after 713 additional blows. The indicated resistance was 31,500 lb.

Section No. 121. Four-inch repressed brick, laid on a 1:3:6 base, 4 in. thick, dry subgrade. This slab resisted 500 blows at ⅛-in. drop, 500 blows at ½-in., and 500 blows at ⅞-in., breaking up under 384 blows at 1¼ in. The indicated resistance was between 28,300 and 31,300 lb. Although the subgrade of No. 121 indicated better bearing power than that of No. 25 the latter showed more resistance than the former.

Section No. 23. Four-inch wire cut lug brick, laid on a 1:3:6 base, 6 in. thick, wet subgrade. This slab resisted 6,000 blows, 500 at each of the ⅛, ½, ⅞, 1¼, 1⅝, and 2-in. drops and 3,000 at 2⅜ in. without showing any signs of failure. The indicated resistance at the 2⅜-in. drop was 39,700 lb.

TABLE 1—B—TESTS OF MONOLITHIC SECTIONS, WITH ONE-QUARTER INCH SAND CEMENT CUSHION

Slab No.	Base.		Cushion.	Surface.		Per cent of moisture.	Bearing value, penetration 50 blows.	Computed resistance.	Height of fall.	Force at failure.
	Thickness.	Mix.		Thickness.	Type.					
	Inches.			Inches.			Inches.	Pounds.	Inches.	Pounds.
25	4	1-3-6	¼-inch sand-cement	4	Wire cut lug	27.6	2.50	31,500	1.27	31,500
128	4	1-3-6	do	4	do	(1)	(1)	(1)	(1)	(1)
121	4	1-3-6	do	4	Repressed	19.8	1.49	28,300	[illegible]	31,300
123	4	1-3-6	do	3½	Vertical fiber	18.3	2.35	21,000	.53	21,000
21	4	1-3-6	do	4	Wire cut lug	21.2	2.46	26,900	.703	26,900
118	4	1-3-6	do	3	do	18.0	1.84	21,400	.55	26,700
23	6	1-3-6	do	4	do	21.0	2.76	39,700	2.58	.....
126	6	1-3-6	do	4	do	(1)	(1)	(1)	(1)	(1)
120	6	1-3-6	do	4	Repressed	(1)	(1)	(1)	(1)	(1)
122	6	1-3-6	do	3½	Vertical fiber	(1)	(1)	(1)	(1)	(1)
20	3	1-3-6	do	3	Wire cut lug	21.3	2.58	12,000	.13	20,400
119	3	1-3-6	do	3	do	18.8	1.68	12,200	.14	20,400
22	2	1-3-6	do	4	do	23.5	2.86	22,300	.50	26,700
129	2	1-3-6	do	4	do	23.2	3.25	20,400	.50	20,400
24	1	1-3-6	do	4	do	23.9	2.48	16,800	.33	20,400
127	1	1-3-6	do	4	do	23.0	2.68	18,300	.40	20,400

[1] Not tested

Summary of the Tests of Monolithic Brick Sections

In general, it can be seen from the above results that the resistance of monolithic slabs is an uncertain quantity, the uncertainty being caused by the fact that the slab acts as a monolith up to a certain point, after which it becomes two independent slabs, when a resistance equal only to the sum of the strengths of the two parts can be expected if top and bottom break at the same instant. If, however, the weaker part breaks before the stronger, then a resistance equal only to that of the latter can be expected. Several of the monolithic slabs indicated that resistance to horizontal shear was greater than the sum of the resistances of top and base in bending.

Slab numbers 22, 25, and 23 indicated resistances slightly greater than would be expected from the two parts of the slabs acting as units but breaking at the same instant. This would indicate excellent adhesion, which resisted horizontal shear between tops and bases. Nos. 118, 121, and 24 showed resistances equal to the sums of the strengths of the tops and bases when acting as units but breaking at the same instant. Nos. 129, 119, 21, 123, and 127 indicated that horizontal shear had developed and the weaker course failed in bending before the stronger, thus showing resistances slightly less than the sum of the two parts.

Comparison of Brick Surfaces and Sand-Cement and Tar-Mastic Cushions

In this group are grout and bituminous filled brick surfaces with 1-in. sand-cement and ½-in. tar-mastic cushions on concrete bases. Representative failures are shown in Figs. 14 and 15, while indicated resistances are given in Table 1-C and curves of center settlement in Fig. 17.

Section No. 8. Four-inch wire cut lug brick, grout filled, on a 1-in. sand-cement cushion and 4-in. 1:3:6 base, wet subgrade. This slab resisted 1,000 blows at the ⅛-in. drop. It developed two cracks and settlement during 990 blows, beginning at the ½-in. drop. From the photographs, Fig. 14, it can be noted that the center did not punch out either in top or foundation. The indicated resistance lies between 18,400 and 20,400 lb.

Section No. 106. Four-inch wire cut lug brick, grout filled, on 1-in. sand-cement cushion and 4-in. 1:3:6 base, dry subgrade. This slab resisted 500 blows at ⅛-in. drop, 500 blows at ½-in., and 500 blows at ⅞-in. It developed the first crack after 875 blows, beginning at the 1¼-in. drop, resulting in settlement and the condition shown by the curves and photographs through 1,315 additional drops. The indicated resistance was 31,600 lb. It will be noted that this slab acted very much like the monolithic sections. Considerably more resistance was shown by No. 106 than by No. 8, and from the bearing power values, as shown by Table 1-C, this was of course to be expected.

Section No. 7. Four-inch wire cut lug brick, grout filled, on a 1-in. sand-cement cushion and 6-in. 1:3:6 base, wet subgrade. This slab resisted 500 blows at ⅛-in. drop, 500 blows at ½-in., 500 blows at ⅞-in., developing two cracks and settlement through 535 blows beginning with 1¼ in. The indicated resistance lies between 26,400 and 31,300 lb.

Section No. 105. Four-inch wire cut lug brick, grout filled, on a 1-in. sand-cement cushion and 6-in. 1:3:6 base, dry subgrade. This slab resisted 500 blows at ⅛-in. drop, 500 at ½-in., 500 at ⅞-in., 500 at 1¼-in., developing cracks and settlement through 615 blows beginning at 1⅝ in. The indicated resistance lies between 31,800 and 34,700 lb. This slab on a dry subgrade showed greater resistance than its duplicate on the wet subgrade, although from the penetration test the dry subgrade seemed to offer less support than the wet, and notwithstanding that the moisture determinations showed considerably less moisture in the dry subgrade than in the wet.

Section No. 4. Three and one-half inch vertical fiber brick, asphalt filled, on a 1-in. sand-cement cushion and 4-in. 1:3:6 base, wet subgrade. This slab offered very little resistance, showing rapid punching out of the center through 365 blows, beginning at the ⅛-in. drop. It is very difficult to say just what resistance was shown by it, but the assumption is made that failure occurred on the 0.18-in. drop with a resulting force of 13,300 lb. Table 1-C shows an extremely bad condition of the subgrade around this slab.

Section No. 10. Three and one-half inch vertical fiber brick, asphalt filled, on a 1-in. sand-cement cushion and 6-in. 1:3:6 base, wet subgrade. This slab resisted 500 blows at ⅛-in. drop, 500 blows at ½-in., developing cracks and settlement through 842 blows at ⅞-in. The resistance is assumed to lie between 24,600 and 26,700 lb.

Section No. 103. Three and one-half inch vertical fiber brick, asphalt filled, on a 1-in. sand-cement cushion and 6-in. 1:3:6 base, dry subgrade. This slab resisted 500 blows at ⅛-in. drop, 500 blows at ½-in., and developed cracks and settlement through 1,508 blows, beginning at ⅞-in. The indicated resistance is 26,700 lb.

Section No. 2. Four-inch wire cut lug brick, tar-sand filler, on a 1½-in. tar-sand cushion and 4-in. 1:3:6 base, wet subgrade. This slab withstood 500 blows at ⅛-in. drop, failing through 530 blows beginning at ½ in., the indicated resistance lying between 14,000 and 20,400 lb.

Section No. 116. Four-inch wire cut lug brick, tar-sand filler, on a ½-in. tar-sand cushion and 6-in. 1:3:6 base, dry subgrade. This slab resisted 500 blows at ⅛-in. drop, 500 blows at ½-in., and 250 blows at ⅞-in., developing rapid settlement through the succeeding 510 blows. The estimated resistance is 26,800 lb.

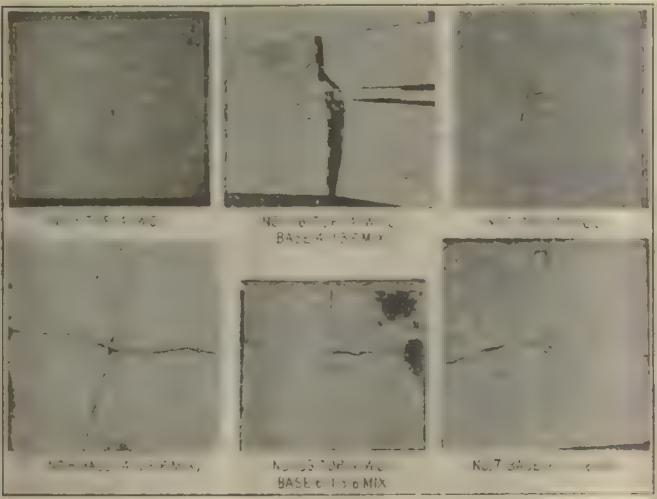

FIG. 14—BRICK TOPS ON CONCRETE BASES WITH 1-INCH SAND-CEMENT AND ½-INCH TAR-MASTIC CUSHIONS (SEMI-MONOLITHIC CONSTRUCTION).

With one exception, the semimonolithic specimens showed less resistance than the monolithic. The exception was No. 106, which showed resistance equal to that of the sum of the top and base. In general, however, little relation could be discovered between the resistance and total thickness of the semimonolithic slabs. Their resistance is possibly affected by the adhesion between the surface and base. Until it is definitely shown that the surface of this type of pavement does not separate from the base, it would not be advisable to expect greater resistance than is offered by the sum of the strengths of the base and top.

In this group are the grout and bituminous filled brick surfaces with sand and screening cushions laid on concrete and macadam bases. Representative failures are shown in Figs. 5 and 6, while the indicated resistances are given in Table 1-D. Center settlement curves are shown in Fig. 17.

Section No. 104. Three and one-half inch vertical fiber brick, asphalt filled, on 1-in. screening cushion and 4-in. 1:3:6 base, dry subgrade. This slab failed under load beginning with the ⅛-in. drop. Its center was punched out during 568 drops. In this case it was assumed that the resisting force was equal to 15,000 lb.

Section No. 6. Three and one-half inch vertical fiber brick, asphalt filled, on 1-in. sand cushion and 4-in. 1:3:6 base, wet subgrade. This slab resisted 500 blows beginning with ⅛-in. drop and had its center punched out in the succeeding 104 blows at the same drop. The indicated resistance of this slab was 20,400 lb.

Section No. 101. Three and one-half inch vertical fiber brick, asphalt filled, on 1-in. sand cushion and 6-in. 1:3:6 base, dry subgrade. This slab resisted 500 blows at ⅛-in. drop, then failed during 608 blows, beginning at ½ in, there being considerable resistance during the first 250 blows at the latter height. The estimated resistance was 23,400 lb.

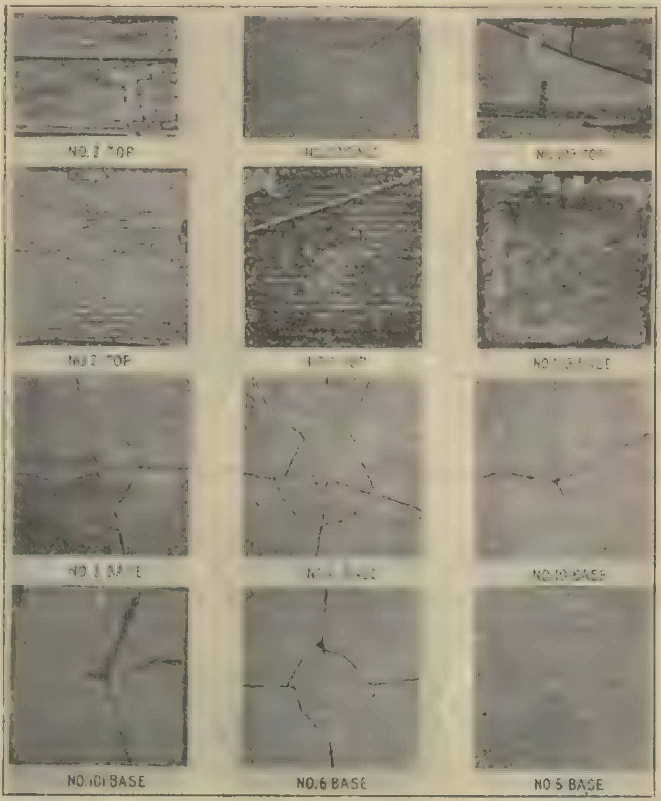

FIG. 15.—BITUMINOUS-FILLED BRICK TOPS ON CONCRETE BASES

Section No. 117. Three and one-half inch vertical fiber brick, asphalt filled, on 1-in. screening cushion and 6-in. 1:3:6 base, dry subgrade. This slab resisted 500 blows at ⅛-in. drop and failed during 658 blows beginning at ⅛ in. The estimated resistance was between 14,900 and 20,400 lb.

Section No. 125. Four-inch wire cut lug brick, grout filled, on a 1-in. screening cushion, no base, dry subgrade. This

Slab No	Thickness of 1-3-6 concrete base.	Cushion.	Surface.		Per cent of moisture.	Bearing value, penetration 50 blows.	Computed resistance.	Height of fall.	Force at failure.
			Thickness.	Type.					
	Inches.		*Inches.*			*Inches.*	*Pounds.*	*Inches.*	*Pounds.*
7	6	1-inch sand-cement	4	Wire cut lug, grout filled	25.0	3.12	26,400	.85	31,300
105	6	....do	4	....do	19.7	3.62	31,800	1.30	34,700
10	6	do	3½	Vertical fiber, asphalt filled	25.2	4.40	24,600	.733	26,700
103	6	.do	3½	....do	19.7	3.71	26,700	.53	26,700
8	4	..do	4	Wire cut lug, grout filled	22.6	3.49	18,400	.39	20,400
106	4	..do	4	....do	17.7	1.89	31,600	1.29	31,600
4	4	do	3½	Vertical fiber, asphalt filled	23.9	5.91	13,300	.18	13,300
2	4	½-inch tar-sand	4	Wire cut lug, tar-sand filled	21.2	2.43	14,000	.21	20,400
116	6	....do	4	do	....	....	26,800	.88	26,800

TABLE 1-C—TESTS OF GROUT AND BITUMINOUS FILLED BRICK SURFACES ON CONCRETE BASES AND 1-IN. SAND CEMENT OR ½ IN. TAR MASTIC CUSHIONS.

slab failed during 502 blows beginning with the ⅛-in. drop. The indicated resistance was 14,800 lb., which is about what can be expected from a 4-in. concrete surface.

Section No. 3. Four-inch wire cut lug brick, grout filled, on a 1-in. screening cushion and 6-in. macadam base, wet subgrade. This slab was damaged before test.

Section No. 1. Four-inch wire cut lug brick, grout filled, on a 1-in. screening cushion and 12-in. macadam base, wet subgrade. This slab resisted 500 blows at ⅛-in. drop and failed completely through 257 blows beginning at ½ in. The estimated resistance was between 14,500 and 20,400 lb.

TABLE 1-D—TESTS OF BRICK SURFACES WITH SAND AND SCREENING CUSHIONS AND CONCRETE AND MACADAM BASES

Slab No.	Base		Cushion		Surface		Per cent moisture.	Bearing value, penetration 50 blows.	Computed resistance.	Height of fall.	Force at failure.
	Thickness	Material	Thickness	Material	Thickness	Type					
	Inches		*Inches*		*Inches*			*Inches.*	*Pounds.*	*Inches.*	*Pounds.*
104	4	1-3-6 concrete	1	Screenings	3½	Vertical fiber, asphalt filled	19.4	2.20	15,000	0.25	15,000
9	6	do	1	Sand	4	Wire cut lug, grout filled	22.2	2.43	25,300	.78	26,700
11	6	do	1	do	4	do	22.8	1.80	23,900	.69	26,700
107	6	do	1	do	4	do	18.0	2.40	29,600	1.10	31,300
114	6	do	1	Screenings	4	do	18.2	2.19	28,700	1.03	31,300
117	6	do	1	do	3½	Vertical fiber, asphalt filled	17.2	1.53	14,900	.24	20,400
102	4	do	1	do	4	Wire cut lug, grout filled	16.0	1.96	12,800	.16	20,400
101	6	do	1	Sand	3½	Vertical fiber, asphalt filled	20.5	3.62	23,400	.66	23,400
5	6	do	1	do	3½	do	25.2	3.83	21,000	.53	26,700
6	4	do	1	do	3½	do	23.7	3.33	20,400	.50	20,400
12	4	do	1	do	4	Wire cut lug, grout filled	23.5	2.88	14,000	.21	20,400
125			1	Screenings	4	do	19.6		14,500	.28	14,500
1	12	Macadam	1	do	4	do	23.8	3.32	14,500	.23	20,400
109	12	do	1	do	4	do					
3	6	do	1	do	4	do	25.2	2.98	(1)	(1)	(1)
131	6	do	1	do	4	do					
108	4	do	1	Sand	4	do	17.8		13,800	.20	20,400

(1) Damaged.

72445—21——

The resistances offered by this last series of slabs were simply those which could be expected from the grouted brick slabs. The base condition can not be compared to that secured when brick is laid on an old gravel or macadam surface as a base.

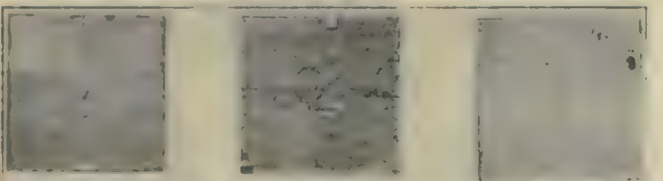

FIG. 16—GROUTED BRICK TOPS ON CONCRETE AND MACADAM BASES

Section No. 12. Four-inch wire cut lug brick, grout filled, on a 1-in. sand cushion and 4-in. 1:3:6 base, wet subgrade. This slab resisted 500 blows at ⅛-in. drop, cracked and settled under 500 blows beginning with ½ in. and 534 blows beginning at ⅞ in. The indicated resistance lies between 14,000 and 20,400 lb.

Section No. 108. Four-inch wire cut lug brick, grout filled, on a 1-in. sand cushion and 4-in. 1:3:6 base, dry subgrade. This slab resisted 500 blows at ⅛-in. drop and became badly broken through 890 blows beginning at ½ in. The indicated resistance lies between 13,800 and 20,400 lb.

Section No. 102. Four-inch wire cut lug brick, grout filled, on a 1-in. screening cushion and 4-in. 1:3:6 base, dry subgrade. This slab resisted 500 blows at ⅛-in. drop and was badly broken by 324 blows beginning at ½ in. The estimated resistance lies between 12,800 and 20,400 lb.

Section No. 9. Four-inch wire cut lug brick, grout filled, on a 1-in. sand cushion, and 6-in. 1:3:6 base, wet subgrade. This slab resisted 500 blows at ⅛-in. drop, 500 blows at ½-in., developing cracks and settlement through 661 blows beginning at ⅞ in. The indicated resistance was between 25,300 and 26,700 lb.

Section No. 11. Four-inch wire cut lug brick, grout filled, on a 1-in. sand cushion and 6-in. 1:3:6 base, wet subgrade. This slab resisted 500 blows at ⅛ in., developing cracks and settlement through 1,429 blows beginning with ⅞ in. The estimated resistance lies between 23,900 and 26,700 lb.

Section No. 107. Four-inch wire cut lug brick, grout filled, on a 1-in. sand cushion and 6-in. 1:3:6 base, dry subgrade. This slab resisted 500 blows at ⅛ in., 500 blows at ½ in., 500 blows at ⅞ in., and cracked and settled through 740 blows at the 1¼-in. drop. The indicated resistance was between 29,600 and 31,300 lb.

Section No. 114. Four-inch wire cut lug brick, grout filled, on a 1-in. screening cushion and 6-in. 1:3:6 base, dry subgrade. This slab resisted 500 blows at ⅛-in. drop, 500 blows at ½ in., 500 blows at ⅞ in., and cracked and settled through 500 blows at 1¼ in. The indicated resistance lies between 28,700 and 31,300 lb.

It can be seen plainly from the foregoing that little can be expected from the above type of construction except the resistance of the stronger part of the slab. Nos. 6, 107, and 114 seem to be exceptions. Also it is to be noted that considerably more settlement occurred before the first crack, caused possibly by the shifting of the sand and screening bed. It can not be seen that the cushioning effect of this sand bed in any way increases the resistance of the pavement.

Indications are that the grouted 4-in. brick surfaces are just as strong as the 4-in. concrete slabs. Also, in general, it would appear that the sections with bituminous-filled brick surfaces show less resistance than similar slabs with grout-filled brick.

(To be continued)

GOOD ROADS

CONSTRUCTION TRANSPORTATION MAINTENANCE

Founded January, 1892

E. L. POWERS
Editor

T. A. HULBERT
Managing Editor

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Copy for classified and other advertisements where proofs are not required will be accepted until noon on Monday of the week of issue.

Articles by road builders are solicited. They should be short and, if possible, accompanied by photographs. Those accepted will be paid for at current rates.

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DESIGNING FOR APPEARANCE AS WELL AS UTILITY

That an engineering work of any kind should be designed to render the maximum service at the minimum expense is recognized as a fundamental principle of engineering. Giving due weight to appearances, also, is not so generally considered an essential part of the designer's work.

The desirability of keeping in mind the aesthetic as well as the utilitarian function of the completed work is nowhere more important than in the planning of roads and streets. A bridge or a building is fixed in one location and, though conspicuous in the immediate neighborhood, is visible over only a comparatively small area. While a road is also fixed as to location, it extends through a long stretch of territory and forms a very conspicuous part of the landscape. Some years ago, Nelson P. Lewis, at that time chief engineer of the Board of Estimate and Apportionment of New York City, pointed out in a paper on the planning of road and street systems that: "While the primary function of a road may be to afford facility of movement from place to place, the interest of road users is not limited to the quickest possible arrival at their destination." Now, even more than when that statement was made, the roads are used for pleasure and recreation and, though the conspicuous disregard for the appearance of the roadsides manifested by some motorists would indicate the contrary, it is a fact that to a large number of tourists and pleasure seekers on the country highways the beauty of the roads is a matter of importance.

It is not necessary that country roads be designed with the same consideration for the aesthetic that is given to the planning of park roads and roads in cemeteries and private estates. On the other hand, it is desirable that those to whom is entrusted the construction of rural roads should make every provision for their beauty that is possible without incurring unwarranted expense. It costs little, if any, more to build a road with pleasing curves and with well-trimmed shoulders and slopes than to build one with monotonously long tangents and with rough, untidy slopes and shoulders. It entails little additional outlay to build guard rails and fences of attractive appearance, nor is it unduly expensive to trim trees and underbrush in such a way as to open up attractive views. Even tree planting along the roadsides does not always mean a cost that is prohibitive. Much can be done at a reasonable cost in the ornamentation of bridges. Most bridges are conspicuous, and a graceful structure in harmony with its surroundings is seldom appreciably more costly than an ugly one.

In many ways besides those mentioned it is possible to enhance the pleasure of the users of the roads without adding materially to the burdens of those who have to pay for their construction. This phase of design deserves more attention than most engineers give it.

New Year's Greetings. To its readers and to all those whom it may reach through them, GOOD ROADS extends New Year's greetings. And not for several years past has it been possible to wish a happy new year with so much confidence and heartiness. A year ago the general business depression had spread its shadow over the work of the road builder and the future was not promising. Two years ago we were facing the reaction of war, divided between thankfulness that the fighting and bloodshed were over and fear for what might follow. The year before that, we were at very nearly the darkest hour of the long struggle. The coming year will find the country at peace with all the world; the general business situation is improving; the uncertainty that hung over the nation's road building program has been cleared, and there is every indication that 1922 will be a record year for accomplishment in the road building field.

The Maintenance of Federal Aid Highways One of the best features of the new federal aid road law is that it possesses "teeth" for the enforcement of the provisions for the maintenance of roads built with federal aid. In presenting to the American Association of State Highway Officials a forecast of work under the new legislation, Chief Thomas H. MacDonald of the Bureau of Public Roads, called especial attention to the matter, stating that: "To insure maintenance, the strongest possible requirements have been written into the law. The act puts the care of federal aid roads after their completion squarely up to the states, and Mr. MacDonald served notice that the law would be "enforced to the letter."

ROAD WARNING SIGN STANDARDIZATION

Use of Same Type of Danger Signs by all State and Other Highway Officials Urged by the Bureau of Public Roads

Sandardize danger signs along American roadways! Make them alike from coast to coast!

So urges the Bureau of Public Roads of the U. S. Department of Agriculture. The recommendation is made for the consideration of highway officials, automobile organizations, municipal officials and all who are interested in the reduction of traffic accidents upon the roads and streets.

By the standardization of all highway danger signs the department believes that automobile accidents may be lessened. Deaths from such accidents have nearly doubled since 1915 and the rapid increase, in the belief of the department, can be appreciably checked by the adoption of standard danger signs, easily read and distinctive, along American highways.

A tourist at present sees almost as many different kinds of signs as there are states visited. Moreover, the style of sign changes in going from one county into another.

The subject is now under consideration by a committee of the American Association of State Highway Officials.

TOWER SYSTEM OF TRAFFIC CONTROL FOR MORE NEW YORK STREETS

The tower system of controlling traffic that has been in operation on part of Fifth Avenue, New York City, will be extended to other streets, an appropriation of $250,000 for that purpose having been made recently.

The system will be operated on the following streets in the Borough of Manhattan: Broadway, between 34th and 110th Sts.; Varick St. and 7th Ave., between Franklin and 59th Sts.; Fourth and Park Aves., between 8th and 86th Sts.; Lafayette St., between Duane and 8th Sts.; 125th St., from river to river; 42d St., from river to river.

It will also be operated on the Grand Concourse, between 161st St. and Fordham Road, in the Bronx, and on Bedford Ave., between Roebling St. and the Eastern Parkway, Borough of Brooklyn.

The Voters of Allegheny County, Pennsylvania, decisively defeated the proposed $27,000,000 bond issue at the November election. The vote was nearly 2 to 1 against each of the several items. The least unfavorable vote was on the portion of the issue proposed for road work

NEW YORK STATE ROAD BUILDERS' ASSOCIATION NOTES

Commissioner Sisson, Deputy Commissioners Sarr and Hotchkiss, and Bridge Engineer Eames attended the meeting of the American Association of State Highway Officials at Omaha, Neb., early this month.

It is expected that the Palenville-Clove Highway will be opened early next spring. When completed, it will form a direct automobile route from Jersey City to the summit of the Catskills and will be one of the most beautiful scenic drives in the East.

The new Rondout Creek Bridge at Kingston, N. Y., was dedicated with appropriate ceremonies on Nov. 29. The structure is the last link in a new state route from Jersey City to Buffalo, running along the west bank of the Hudson River to Albany. Commissioner Sisson and his predecessor, Capt. Frederick Stuart Greene, were present, as were Governor Miller and Former Governor Smith. The latter laid the cornerstone of the bridge in 1919.

It is estimated that 615.49 mi. of road have been built in New York State during the past season. Reinforced concrete pavement was laid on 366 mi. The contracts awarded amounted to $25,535,084.88 and over $7,000,000 has been paid to contractors. The division extending from Poughkeepsie to Suffolk County leads with a total of 94 mi. completed; the Buffalo division is second with 92 mi.; the Utica division has laid 82 mi., and the Syracuse division 68. The Albany division built 61.17 mi.

Commissioner Sisson is to try out the plan of planting elm trees along the state highway route between Buffalo and New York City in memory of the soldiers who made the supreme sacrifice in France. The plan was proposed at a conference between officials of the Conservation Commission and the State College of Forestry. It has been decided to start the work on the 10-mi. stretch between Utica and Syracuse, early next spring. The Conservation Commission and the College of Forestry will supply the trees and the State Highway Department will supply the trucks to move them.

Another interesting letting took place on Nov. 22. It brought a number of new contractors into the field. Construction contracts were awarded for nine roads and reconstruction contracts for two. The nine contracts awarded amounted to a total of $1,239,605. There were 27 bidders on the Wurtsboro-Ellenville Road and 25 on the Skinnersville-New Home Bridge. The Hendrickson McCabe Construction Co., Syracuse, was awarded the contract for the Caledonia-Mount Morris job in Livingston County, at $43,276.50. J. F. Paddelford, Sherburne was awarded the contract for the Garretsville-West Burlington work in Otsego County.

MEETINGS

Calendar of Coming Meetings

Jan. 5-6—Federated American Engineering Societies. —Annual Meeting, Washington, D. C.

Jan. 17-19—Iowa Engineering Society.—Thirty-fourth Annual Meeting, Sioux City, Iowa. Secretary, L. A. Canfield, Des Moines, Ia.

Jan. 17-19—Associated General Contractors of America—Third Annual Meeting, Hotel Winton, Cleveland, Ohio. General Manager, R. C. Marshall, Jr., 1038 Munsey Bldg., Washington, D. C.

Jan. 17-20, 1922—American Road Builders' Association.—Nineteenth Annual Convention, Twelfth Americal Good Roads Congress and Thirteenth Good Roads Show under the auspices of the A. R. B. A., The Coliseum, Chicago, Ill. Secretary, E. L. Powers, 11 Waverly Place, New York, N. Y.

Feb. 12-17—Conference on Highway Engineering.—Eighth Annual Conference, University of Michigan, Ann Arbor, Mich.

ASSOCIATED PENNSYLVANIA HIGHWAY CONTRACTORS

The second anunal meeting of the Associated Pennsylvania Contractors was held at Harrisburg, Pa., on Dec. 15, followed by a conference on highways on the 16th.

Officers for the coming year were elected as follows: President, William D. Hill, of the Samuel Gamble Co., Pittsburgh; First Vice President, Samuel M. Irwin, of the Union Paving Co., Philadelphia; Treasurer, Lea Hunt, of the Hand-Hunt Co., Wilkes-Barre. The board of directors reappointed Charles F. Puff, Jr., to serve as secretary.

The forenoon session of the conference was devoted to the discussion of matters of interest to bankers and surety companies, engineers, and material producers. The afternoon session was given over to the consideration of equipment and of matters of interest to the state highway department officials and engineers.

Several resolutions were passed as a result of the morning's deliberations. One of them called upon surety companies to lower their rates and select their risks with more care. Another suggested the possibility of lowering construction costs by the modification of the state highway specifications to permit the use of other than extremely hard coarse aggregates. Another urged the reduction of freight rates on sand and stone, and still another urged the possibility of reducing costs by the adoption of a more binding contract between the contractor and the producer.

Among the speakers at the morning session were: E. J. Stackpole, a director of the First National Bank of Harrisburg; E. C. Lunt, Vice President of the Fidelity & Casualty Co., New York, N. Y.; Williaim McIntyre, of the Atlas Portland Cement Co.; Ernest Ashton, of the Lehigh Portland Cement Co.; Herbert Allen, of the General Crushed Stone Co.; J. E. Carroll, of the J. E. Carroll Sand & Gravel Co.; William King, of the Texas Co., and Louis Young, of the Atlantic Refining Co.

During the discussion of equipment, talks were given by representatives of the Galion Iron Works & Mfg. Co., the Koehring Company, the Lakewood Engineering Co., and the Blaw-Knox Co. After the discussion, the meeting adopted a resolution urging greater standardization of equipment and suggesting a series of conferences to that end between the Associated General Contractors and the equipment manufacturers.

There was a dinner on the evening of the 16th, at which there were several speakers. Among them were Lieutenant-Governor Beidleman of Pennsylvania; Daniel A. Garber, a director of the Associated General Contractors; Charles F. Puff, Jr., Secretary and General Manager of the Associated Pennsylvania Contractors; Henry H. Wilson, the retiring president, and W. D. Hill, president-elect, of the Associated Pennsylvania Highway Contractors.

AMERICAN ROAD BUILDERS' ASSOCIATION

The tentative program Twelfth American Good Roads Congress of the American Road Builders' Association, which will be held at the Coliseum, Chicago, Ill., Jan. 16 to 20, inclusive, provides for a public session and six technical sessions, each of the latter to be devoted to some special phase of road and street work.

The public session, the formal opening of the meeting, will be devoted to addresses of welcome and responses and to addresses by distinguished delegates and visitors.

The technical sessions will be devoted to the following general topics: Bituminous Roads; Portland Cement Concrete Roads; Common Roads; Highway Financing; Highway Traffic and Transportation; and Highway Research.

Among those scheduled to present papers are the following: Hugh W. Skidmore, of the Chicago Paving Laboratory; C. M. Pinckney, Chief Engineer of the Manhattan Bureau of Highways, New York City; W. A. Welch, Chief Engineer of the Palisades Interstate Park Commission; L. M. Law, Chief Chemist of the New Orleans Refining Co.; Roy M. Green, Manager of the Western Laboratories; Bruce Aldrich, of Toronto, Ont.; Prevost Hubbard, Chemical Engineer of the Asphalt Association; John H. Mullen, Chief Engineer of the

Minnesota State Highway Department; W. D. Uhler, Chief Engineer of the Pennsylvania State Highway Department; R. W. Crum, Testing Engineer of the Iowa State Highway Commission; H. E. Breed, Consulting Engineer; P. C. McArdle, County Highway Superintendent of Vermilion County, Illinois; Edward N. Hines, Chairman of the County Highway Commission of Wayne County, Michigan; T. J. Wasser, State Highway Engineer of New Jersey; W. F. Purrington, Chemist and Testing Engineer of the New Hampshire State Highway Department; A. R. Hirst, State Highway Engineer of Wisconsin; C. M. Babcock, Commissioner of Highways of Minnesota; J. G. McKay, Professor of Economics, University of Wisconsin; Prof. W. K. Hatt, Director of the Advisory Board on Highway Research of the National Research Council; Clifford Older, Chief Highway Engineer of Illinois; A. T. Goldbeck, Chief of the Testing Division of the U. S. Bureau of Public Roads; T. H. MacDonald, Chief of the U. S. Bureau of Public Roads; A. R. Losh, Assistant, Bureau of Construction, U. S. Bureau of Public Roads; Jay Downer, Chief Engineer of the Bronx Parkway Commission; D. C. Fenner, Manager of the Public Works Department of the International Motor Co.; George E. Johnson, Secretary of the Nebraska Department of Public Works; Herbert Nunn, State Highway Engineer of Oregon; William Ord, Manager of the Paving Department of the Lakewood Engineering Co.; C. M. Upham, State Highway Engineer of North Carolina; H. H. Wilson, of Winston Bros., Muncy, Pa.

CONFERENCE ON STANDARDIZATION OF CONSTRUCTION CONTRACTS

Preliminary steps towards the standardization of construction contracts of all kinds were taken at a conference held at the Department of Commerce, Washington, D. C., on Dec. 15 and 16.

The meeting was called as the culmination of a study of the subject conducted by the Associated General Contractors of America and was attended by representatives of that body and of the American Association of State Highway Officials, the American Engineering Council, the American Institution of Architects, the American Railway Engineering Association, the American Society of Civil Engineers, the American Waterworks Association, the National Association of Builders' Exchanges, and the Western Society of Engineers.

The conference was opened by Secretary Hoover of the Department of Commerce, who expressed his approval of the object of the meeting and promised the support of the department for any plan the delegates might agree upon. Among those who discussed the subject were Gen. R. C. Marshall, Jr., General Manager of the Associated General Contractors; H. K. Bishop, General Inspector, Bureau of Public Roads, representing the American Association of State Highway Officials, and W. A. Rogers, President of Bates & Rogers, Chicago, Ill., representing the Western Society of Engineers.

In discussing the matter from the road builders' point of view, Mr. Bishop described the standardization of contract forms by the Bureau of Public Roads in connection with federal aid work. He said, in part:

"In general, we used the short form of contract, covering only one or two pages, making all the specifications, which carry all of the standard clauses, a part of the contract. Even the sheets were of standard size and typography, and we went so far as to standardize the structures. Now, you will find that if you pick up specifications in one state you can't tell what state it is until you look to see on the title page. And we find that the counties are gradually following the states, so that this standardization is extended not only to the forty-eight states of the Union but to most of their subdivisions. We have found that it very much simplifies the work."

The final session of the conference was devoted to a detailed study of clauses which could be approved for incorporation into the standard contract "agreement," the members voting on each topic separately until a definite list of topics had been made which seemed acceptable for universal use. It was the consensus of opinion that such a universal document could be achieved, its scope or length, however, having to be determined by detailed consideration of each separate topic. It was decided that sub-committees should be appointed later in each branch of the industry to draw up the general form of "general conditions" for each branch to complement the general "agreement" according to the nature of the work.

A committee, consisting of Gen. Marshall, for the contractors, W. S. Parker, for the architects, and W. D. Faucette, for the railway engineers, was appointed to draw up the document in tentative form for correction and approval by the conference at another meeting in January. Following that, the forms will be transmitted to the various societies and organizations concerned for further consideration and ultimate adoption.

ALABAMA TO VOTE ON BOND ISSUE

For the second time the question of a state road bond issue is to come before the people of Alabama, Governor Kilby having issued a proclamation calling a special election on Jan. 30, 1922.

In 1920 the voters of the state signified their approval of an amendment to the constitution permitting a $25,000,000 road bond issue. The Supreme Court of the state, however, declared the measure unconstitutional in February of this year.

According to reports from the state the present proposition, which calls for a $25,000,000 bond issue, is likely to be acted upon favorably. The original bill was carried by a large majority and since it was declared unconstitutional several counties have voted bond issues to raise road funds to be turned over to the State Highway Department.

CONTRACT NEWS

ROADS AND STREETS

Bids Asked and Prospective Work

Anniston, Ala.—Bids will be received until Jan. 3 by city for construction of 25,000 sq. yds. street paving; asphaltic concrete, bitulithic brick or Tarvia penetration on reconstructed slag base or Portland cement concrete, involving 26,000 lin. ft. combined curb and gutter, etc. Address Robert L. Totten, Conslt. Engr., Birmingham, Ala.

Athens, Ala.—Bids will be received until Dec. 30 by city for the construction of curb, gutter, paving and spread seal coat on certain waterbound macadam streets within districts described in Ordinances 33 and 34; involving 15,836 lin. ft. concrete curb and gutter; 50,700 sq. yds. bituminous seal coat; 2,900 sq. yds. waterbound macadam with seal coat, etc. Address S. A. Davis, Clk.

Selma, Ala.—City prepares plans for paving North Broad St.; estimate $50,000. Address W. O. Cristman, City Engr.

Pine Bluff, Ark.—City prepares plans for paving streets, involving 8 mi. concrete, asphalt and macadam pavement; estimate $425,000. Address J. H. Guest, City Engr.

San Francisco, Cal.—City will soon receive bids for paving various streets; estimate $100,000. Address City Clk.

Jacksonville, Fla.—Bids will be received by city for laying 19,360 sq. yd. asphaltic concrete base. Address Paving Comn.

Jacksonville, Fla.—Bids will be received until Dec. 29 by city for construction of 22,230 sq. yds. asphaltic concrete pavement on 6 in. concrete base; estimate $113,988. Address W. E. Sheddan, Acting City Engr.

Deland, Fla.—Bids will be received until Jan. 5 by State Road Dept., Tallahassee, Fla., for construction of 19.239 mi. compact rock base or shell base on section of State Road o. 3 in Valusia Co. between south line of Putnam Co. and DeLeon Springs. Address H. B. Phillips, Chmn.

Gainesville Fla.—Bids will be received until Jan. 5 by State Road Dept.. Tallahassee, Fla.. for construction of 12.602 mi. compacted rock base and bituminous macadam wearing surface on section of State Road No. 2 known as Federal Aid Project No. 33 in Alachua Co. between Burnetts Lake and Gainesville; alternate bids on cement concrete, sheet asphalt, bituminous concrete and cement grouted brick. Address H. B. Phillips, Chmn.

Orlando, Fla.—Bids will be received until Jan. 5 by State Road Dept. Tallahassee, Fla. for construction of 8.594 mi. compacted rock base and bituminous macadam wearing surface on section of State Road No. 2 known as Federal Aid Project No. 13 in Orange Co. between Plymouth and Mt. Dora. Address H. B. Phillips, Chrmn.

Palatka, Fla.—Bids will be received until Jan. 10 by city, for construction and setting of 20,000 lin. ft. concrete curb; laying of 13,000 sq. yds. brick paving. Address John H. Randolph, City Engr.

Palatka Fla.—Bids will be received until Jan. 5 by State Road Dept., Tallahassee, Fla., for construction of 12.791 mi. of bituminous macadam road on section of State Road No. 3 known as Federal Aid Project No. 18, located in Putnam Co. between Sisco and north line of Volusia Co. Address H. B. Phillips, Chmn.

Challis, Idaho—Bids will be received by State Highway Dept. at office of district engineer, Challis, until Jan. 9 for the construction of 5,78 mi. road in Custer Co., involving 20,115 cu. yd. earth excavation and 36,700 cu. yd. rock excavation and 19,075 sta. wd. overhaul. Address H. A. Turner, Dis. Engr.

Lewiston, Idaho—Bids will be received by State Highway Dept. until Jan. 12 at office of district engineer, Lewiston, for grading 6.4 mi. road in Lewis Co. Address Wm. Osborn, Dis. Engr.

Joliet, Ill.—Plans will be prepared by Grundy Co. for the construction of 1.5 mi. macadam road. Address Co. Clk.

Joliet, Ill.—City prepares plans for paving Center St.; estimate $53,000. Address City Clk.

Bluffton, Ind.—Bids will be received by Wells Co. until Dec. 30 for the constructcion of 5,085 ft. crushed stone road in Lancaster Twp. Address Co. Aud.

Boonville, Ind.—Bids will be received by Warrick Co. until Jan. 3 for the construction of road in Hart Twp.; estimate $38,680.

Columbus, Ind.—Bids will be received by Bartholomew Co. until Jan. 3 for the construction of 6,025 ft. gravel road; estimate $6,150. Address Co. Aud.

Corydon, Ind.—Bids will be received by Harrison Co. until Jan. 3 for the construction of three crushed stone roads; 2,650, 11,460 and 13,373 ft. in length. Address Co. Aud.

Evansville, Ind.—Bids will be received by Vanderburgh Co. until Jan. 9 for the construction of road in Perry Twp.; estimate $16,422. Address Co. And.

Hammond, Ind.—Bids will be received by City until Dec. 30 for the grading and paving of various streets. Address City Clk.

LaGrange, Ind.—Bids will be received by LaGrange Co. Jan. 5 for the construction of number of roads. Address Co. Aud.

Marion, Ind.—Bids will be received by Grant Co. until Jan. 4 for the construction of 4,000 ft. road. Address Co. Aud.

Newport, Ind.—Bids will be received until Jan. 2 by Vermillion Co. for the construction of two roads in Vermillion and Clinton Twps. Address Co. Aud.

Petersburg, Ind.—Bids will be received by Pike Co. for the construction of several roads. Address Co. Aud.

Rockport, Ind.—Bids will be received by Spencer Co. until Jan. 2 for the construction of four roads. Address Co. Aud.

Rockville. Ind.—Bids will be received by Parke Co. until Jan. 3 for the construction of 10 511 ft. gravel road in Penn Twp. Address Co. Aud.

Shelbyville, Ind.—Bids will be received by Shelby Co. until Jan. 4 for the construction of 15 225 ft. and 5 292 ft. gravel roads, one 6 135 ft. concrete and one 11.257 ft. crushed stone road. Address Co. Aud.

Spencer, Ind—Bids will be received by Owen Co. until Jan. 2 for the construction of two roads in ontgomery and Marion Twps. Address Co. Aud.

Terre Haute, Ind.—Bids will be received by Vigo Co. until Jan. 3 for the construction of road in Prairie Creek Twp., estimate $14.558. Address Co. Aud.

Washington Ind—Bids will be received by Daviess Co. until Jan. 2 for the construction of road in Bogard Twp. Address Co. Aud.

Williamsport, Ind.—Bids will be received by Warren Co. until Jan. 2 for the construction of three gravel roads, 9 315 3,956 and 14,505 ft. in length. Address Co. Aud.

Clarinda, Ia.—Bids will soon be received by city for 38.000 sq. yd. paving. Address Henry Traxler, Engr.

Decorah, Ia.—Bids will be received by Winneshiek Co. until Dec. 29 for the grading and draining Decorah-Locust Rd., involving 32,027 cu. yd. earth excavation and 25,775 lin. ft. 6 in. tile. Address Co. Aud.

Hampton, Ia.—Bids will be received by Franklin Co. until Dec. 30 for the construction of 4.1 mi. gravel road, involving 6,150 cu. yd. gravel. Address Co. Aud.

Eagle River, Mich.—Bids will be received until Jan. 12 by State Highway Dept. at office of Bd. of Co. Rd. Comrs. of Keweenaw Co. for shaping, draining and surfacing with gravel 8.6 mi. road. Address F. F. Rogers, State Highway Comr., Lansing.

Grand Rapids, Mich.—Bids will be received until Jan. 10 by State Highway Dept. at office of Bd. of Co. Rd. Comrs. of Kent Co. for shaping, draining and surfacing with gravel 0.5 mi. road. Address F. F. Rogers, State Highway Comr., Lansing.

Laurel, Miss.—Bids will be received until until Dec. 30 by city for construction of 24,39 sq. yds. brick pavement with concrete foundation, involving 7,674 lin. ft. concrete header and 4 564 lin. ft. concrete curb. Address G. L. Lightsey, Clk.

Winona, Miss.—Bids will be received until Jan. 3 by city for construction of 14.,081 sq. yds. monolithic concrete paving; 3,200 ft. curb and gutter. Address W. F. Blackston, Clk.

Gastonia, N. C.—Bids will be received until Jan. 3 by Gaston Co. for paving 8 mi. of roads. Address D. L. Struthers, Highway Engr.

Hamlet, N. C.—City prepares plans for hard-surfacing streets and installing sanitary sewers; estimate about $80,000. Address the Mayor.

Akron, O.—Bids will be received by city until Jan. 3 for paving, grading and constructing sidewalks on various streets. Address E. A. Zeisloft, Dir. Pub. Service.

Mangum, Okla.—Bids will be received by city until Dec. 28 for paving carious streets with asphaltic concrete on concrete base. Address Benham & Mullergren, Engrs., Kansas City, Mo.

Jasper, Tex.—Bids will be received until Jan. 10 by Jasper Co. for the construction of 11.1 mi. gravel road with concrete drainage structures. Address C. P. Hunter, Co. Engr.

Montesano, Wash.—Bids will be received by Grays Harbor Co. until Jan. 3 for the construction of 1.5 mi. gravel road. Address Co. Aud.

Kakima, Wash.—Bids will soon be received by Kakima Co. for the construction of 2.5 mi. gravel road. Address Co. Clk.

Lewisburg, W. Va.—Bids will be received by Greenbrier Co. until Jan. 3 for grading, draining and paving 5 mi. road. Address J. W. Radler, Co. Engr.

Milwaukee, Wis.—City plans to widen Biddle and Cedar Sts.; estimate $2,500,000. Address Daniel W. Hoan, Mayor.

Bids Received and Contracts Awarded

Morrilton, Ark.—City let contract for paving streets, concrete base 6 in. thick and 2 in. asphaltic top concrete gutters and curbing, to Morena-Burkman Co., St. Louis, Mo., at $101,000.

Dunedin, Fla.—City awarded contract for paving streets to James G. Yeasts Co., Tampa, at $74,630.

Lansing, Mich.—State Highway Dept. awarded contract for clearing 13 mi. road in Chippewa Co. to Hill Bros., Chatham, at $4 68 : 7.74 mi. gravel road in Antrim and Charlevoix Cos. to L. W. Edison, Grand Rapids, at $77,930.

Breckenbridge, Minn.—City awarded contract for paving seven blocks of 8th St. to E. W. Coons Co., Hibbing, at $84,601.

ROAD BUILDERS' EXCHANGE

Special

Road Building Equipment

- 1—6 Ton Kelly Springfield Tandem Roller. Excellent Condition.
- 1—10 Ton, 3 wheel New Huber Roller. Like new.
- 2—600 gallon Kinney Pressure Distributers.
- 2—[illegible] Dryers complete each 3 feet 6 inches by 16 inches. Like new.
- 2—500 Gallon Asphalt Kettles on wheels.
- 1—40-H.P. Ames Boiler on wheels with Engine on frame.
- 1—[illegible] cubic feet -Sullivan Gasolene Driven Compressor on wheels.
- 1—No. 2½ Climax Portable Crusher complete with bins, screens, boiler, engine, etc.
- 1—14E Koehring Mixer with Steam Power, Boom and Bucket. Like new.
- 1—No. 16 Koehring Mixer with Steam Power, Boom and Bucket—Rebuilt.

W. B. SPENCER

150 Nassau St. New York City

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Reasonably **ROAD BUILDING PLANT** **Priced**

- 6 Model 3 Keystone Shovels. Shop Nos. 272, 290, 315, 346, 525 and 562; all with ½ yd dippers.
- 30,000 ft. Lakewood 24 in. gauge 20 lb. portable track, 15 ft. sections, with turnouts complete.
- 4 Lakewood 1½ yd. 24 in. gauge V body dump cars, extra heavy types. Cat. style No. 241.
- 34 Lakewood heavy duty batch box cars with Hyatt roller bearings, brakes, and boxes.
- 4 6-ton 24 in. ga. Whitcomb Locomotives.
- 4 6-ton 24 in. ga. Cummings Locomotives.
- 2 7½-ton 24 in. ga. Baldwin Locomotives. 50 HP 4 cyl. engines, self starters, electric lights and signals. Two speeds either direction, gear transmission, multiple disc clutch. Send for photo. Guaranteed good as new.
- 2 Multi-Foote Pavers, 32 cu. ft. cap, 1 steam—1 gasoline.
- 1 Foote Paver, Shop No. 1484, self propelling, steam driven, 2 bag batch. Overhauled, ready for work.
- 1 14E Rex Paver, caterpillar traction.
- 1 No. 11 Koehring Paver, wheel traction.
- 3 Lakewood sub-graders.
- 1 7-ton guy derrick, 55 ft. boom.
- 1 7-ton stiff derrick, 60 ft. boom.
- 5 Lakewood finishing machines. 16 ft., 18 ft., and 20 ft.
- 1 10-ton Buffalo-Pitts steam roller.
- 1 10-ton Austin gasoline road roller.
- 1 No. 9¾ D Acme 11x20 portable, with folding elevator and revolving screens. Used four months only, and since overhauled.
- 1 Barber Greene wagon loader, reversible traction and self-feeding rotating discs, driven by 4 cyl. Buda gasoline motor. New 1920.
- 1 Type B Erie shovel, new 1917. Rebuilt.
- 1 35 HP Farquhar portable boiler and engine.
- 1 Derrick car, 8 wheel, M. C. B.
- 1 20-ton 8 wheel Ohio Crane. 50 ft. boom.
- 1 20-ton Browning Crane, 8 wheel, 50 ft. boom. Will rent.
- 1 Ledgerwood 7x10 DC DD hoisting engine and boiler.
- 1 Lambert 7x10 DC DD skeleton hoist.

READING ENGINEERING COMPANY, Inc.

154 Nassau Street **New York City**

Locomotives
For Light and Heavy Service

Narrow and standard gauge. Any type or weight. Large stock to make selection.—IMMEDIATE SHIPMENT FROM STOCK.

Southern Iron & Equipment Co.

Atlanta, Ga. **New Orleans, La.**

Sante Fe, New Mex.—State Highway Dept. on Dec. 20 awarded following contracts:

State Aid Project; Cerrillos-Madrid, Santa Fe County. Length of project 3.140 miles, located between Cerrillos and Madrid, to Peterson, Shirley and Gunther, Omaha, Nebraska, at $17,262.40.

Federal Aid Project No. 70, Lea County. Length of project 14.181 miles, located between Sarlsbad and Lovington, to Duvall, Johnston and Sappington, Roswell, N. M., at $19,768.75.

Federal Aid Project No. 61-B, Bernalillo County. Length of project 6.698 miles, located between Albuquerque and Pajarito to New Mexico Construction Company, Albuquerque, N. M., at $125,371.08.

Federal Aid Project No. 66, Dona Ana County. Length of project 6.809 miles, located between Berino and Anthony, to New Mexico Construct'on Company, Albuquerque, N. M., at $112,221.46.

The following contractors submitted bids: J. V. Stryker Construction Company, Denver, Col.; Peterson, Shirley and Gunther, Omaha, Neb.; Duvall, Johnston and Sappington, Roswell, New Mex.; New Mexico Construction Company, Albuquerque, N. M.; Kroager & Hayner, Las Cruces, N. M.; Lee Moor Contracting Company, El Paso, Texas; C. E. Mauldin, Clovis, N. M.; Hoopes Construction Company, Tucson Ariz.; Anderson Construction Company, El Paso, Texas; W. T. McClure, Magdalena, N. M.; H. R. Phillips, 501 Ra'lroad Bldg., Denver, Col.; E. A. Caples, 215 N. Kansas St., El Paso, Texas; Levy Construction Company, Denver, Col.; J. Fred Roberts & Sons Construction Co. Denver, Col.; A. H. Webster, Amarillo, Texas; C. D. Golden, Douglas, Ariz.; J. R. Dooley Santa Fe, N. M.; Atlas Construction Company, La Veta, Col.

Bakersville, N. C.—North Carolina State Highway Dept., Raleigh, N. C., let contract for Project 856 in Mitchell Co. between Spruce Pine and Ledger, involving 7.04 mi. penetration macadam road on Route No. 19 to Porter and Boyd Charlotte, N. C., at $199,132; structures to L. J. Chandler, Virgilina, Va., at $18,146.

Charlotte, N. C.—North Carolina State Highway Dept. Raleigh, N. C., let contract for Project 655 involving 1.57 mi. hard-surface road in Mecklenburg Co., east of Charlotte toward Monroe, to Speed-Parker Co., Louisville, Ky. at $51,088.

Franklin N. C.—North Carolina State Highway Dept. Raleigh, N. C., let contract for Project 980 involving 17.84 mi. waterbound macadam road in Macon-Swain Counties between Topton and Almond on Route No. 10, to E. A. Wilson Co., Knoxville, Tenn. at $284,070; structures to Southern Dray Co., Asheville, N. C., at $28 803.

Gastonia, N. C.—Gaston Co. let contract for construction of 5 mi. hard-surface road, to Simmons Construction Co., Charlotte N. C. at $10,000.

Hayesville, N. C.—North Carolina State Highway Dept. Raleigh, N. C. let contract for Project 9 0 involving 5.01 mi. gravel road in Clay Co. between Hayesville and Georgia State Line on Route No. 109, to E. A. Wilson Co., Knoxville Tenn. at $33,838; structures to W. T. Moore Concrete Products Co., Andrews, N. C. at $16,048.

Hendersonville, N. C.—North Carolina State Highway Dept. Raleigh N. C. let contract for Project 833 in Henderson Co., involving 5.20 mi. gravel road between Horseshoe and Transylvania Co. line on Route No. 28 to Sam Davis Construction Co., Greensboro, N. C. at $26,312; structures to Asheville Construction Co., Asheville, N. C. at $8,067.

Hillsboro, N. C.—North Carolina State Highway Dept. Raleigh, N. C. let contract for Project 456 in Orange Co. between Hillsboro and Alamance Co. line, involving 9.87 mi. soil road, to Crawford and Chawford, Mebane, N. C. at $17,452.

Cuero, Tex.—De Witt Co. awarded contract for the construction of 10.3 mi. gravel road to W. T. Hutto & Sons, Gonzales, at $64,139.

BRIDGES AND CULVERTS

Bids Asked and Prospective Work

Pensacola, Fla.—Bids will be received until Jan. 10 by Escambia Co. for the construction of concrete bridge with concrete abuttments and earth approaches across Carpenter's Creek. Address James MacGibbon, Clk.

Carlinville, Ill.—Bids will be received by Macoupin Co. until Jan. 7 for the construction of two creosoted pile abutments, cleaning and painting existing steel truss and laying oak floor. Address O. B. Conlee, Co. Supt. of Highways.

Challis, Idaho—Bids will be received by State Highway Dept. until Jan. 9 at office of district engineer, Challis, for the construction of three wooden bridges in Custer Co. Address H. A. Turner, Dis Engr.

Lewiston, Idaho—Bids will be received by State Highway Dept. until Jan. 12 at office of district engineer, Lewiston, for the construction of one 20 ft. bridge in Lewis Co. Address Wm. Osborn, Dis Engr.

Audubon, Ia.—Bids will be received by Audubon Co. until Jan. 5 for the construction of two bridges. Address Harry Clark, Co. Engr.

Bedford, Ia.—Bids will be received by Taylor Co. until Dec. 30 for the construction of 47 culverts and 4 bridges. Address S. R. Wier, Co. Engr.

Charles City, Ia.—Bids will be received by Floyd Co until Dec. 29 for the construction of five concrete arch bridges. Address G. H. Elliott, Co. Engr.

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Clinton, Ia.—Bids will be received by Clinton Co. until Jan. 19 for the construction of bridges and culverts on primary road project No. 125. Address E. B. Lorenzen, Co. Engr.

Clinton, Ia.—Clinton and Scott Cos. will build bridge over Wapsie River; estimate $80,000.

Sedwick Kan.—Bids will be received until Jan. 5 by Sedgwick Co. for construction of 250 ft. rein. concrete girder bridge; estimate $50,000. Address M. Roseberry, Engr., Wichita.

Boston, Mass.—City has prepared pains for the construction of bridge to cost $300,000. Address John A. Carty, City Engr.

Saginaw, Mich.—Bids will be received until Jan. 9 by State Highway Dept. at office of Bd. of Co. Rd. Comrs. of Saginaw Co. for the construction of rein. concrete abutments for steel bridge over Flint River. Work involves 651 cu. yd. concrete and 63,556 lb. reinforcing steel. Address F. F. Rogers, State Highway Comr., Lansing

Bemidji, Minn.—Beltrami Co. has prepared plans for 375 ft. bridge. Address A. D. Johnson, Co. Aud., St. Paul.

New Albany Miss.—Bids will be received until Dec. 29 by State Highway Dept., Jackson, Miss. for constriction of 2 concrete bridges on highway between ew Albany and Memphis.

Tarentum, Pa.—Bids will be received by City until Feb. 10 for the construction of bridge over Hull Creek at Mill St. Address R. E. Walters, City Engr.

Bids Received and Contracts Awarded

Benton, Mo.—Scott Co. let contract for 16 ft. wood bent creosoted pile and 3 steel bridges to Cox & Tant, Sikeston, Mo., at $15,097; C. E. Swank, Engr., Charleston, Mo.

Edenton, N. C.—North Carolina State Highway Dept., Raleigh, N. C. let contract for bridges in Chowan Co., to P. R. Ashby, Raleigh, N. C., at $23,409.

Morgantown, N. C.—North Carolina State Highway Dept., Raleigh, N. C. let contract for bridges in Burke Co., to Southern Dray Co., Asheville, N. C., at $3,890.

Rutherfordton, N. C.—North Carolina State Highway Dept., Raleigh, N. C. let contract for bridge over Mountain Creek in Rutherford Co., to Austin Bros. Bridge Co., Atlanta, Ga., at $5,215.

Bamberg, S. C.—Bamberg Co. will construct 613 ft. rein. concrete bridge over Edisto River on Orangeburg-Bamberg Rd., Address Co. Clk.

Belton, Tex.—Steel bridge over Salado River, Bell Co., will be replaced. Address Co. Judge, Belton.

Houston, Tex.—The City Council is planning the replacement of the Sabine St. bridge; estimate cost, $150,000. Address City Engr.

La Grange, Tex.—Fayette Co. prepares plans for 1,200 ft. bridge over Colorado River; estimate $300,000. Address A. Schlaffi, Engr., Schulenburg.

Madison, Wis.—The State Highway Comn. has recommended the construction or reconstruction of bridges to county boards, as follows: Madison, 4 township bridges. Address F. M. Lipke, Co. Highway Comr., of Dane Co.; Stevens Point, 1 bridge, estimated cost, $2,150. Address J. T. Henton, Highway Comr., of Portage Co.; Green Bay, 4 bridges, Address Geo. J. Cormier, Highway Comr, of Brown Co.; Sturgeon Bay. 1 bridge estimated cost $1,250. Address J. M. Laurie Comr. of Door Co.; Manitowoc, 3 bridges, estimated cost of $2,500. Address Frank Muth, Highway Comr., of Manitowoc Co.

Toronto, Ont.—City prepares plans for steel bridge over ravine on St. Claire Ave.; estimate $712,000. Address R. C. Harris, Comr. of Pub. Wks.

Bids Received and Contracts Awarded

Raleigh, N. C.—State Highway Comn. let contracct for rein, concrete bridges and culverts in Iredell and Mecklenberg Cos. to Luten Bridge Co., Knoxville Tenn., at $30,325.

Columbus, O.—Franklin Co. let contract for 800 ft. steel bridge to E. M. Scully, Columbus, at $135,000.

Montpelier, Vt.—State Highway Dept. awarded contract for construction of Sherburne Bridge to Earle & Merry, Rutland, at $8,682.

BONDS

Miami, Fla.—The City has voted $110,000 bonds for the construction of Avenue G. Bridge and bids will soon be asked. Address C. S. Coe, City manager.

Starke, Fla.—Bradford Co. has voted $550,000 bonds to pave 25 mi. of highway between Alachua and the Marion Co. line and 15 or 20 mi. of lateral roads, probably with asphalt.

Rock Island, Ill.—City has passed ordinance providing for the issuance of $110,000 of municipal bonds for constructing proposed bridge. Address Mayor.

Jefferson City, Mo.—The Senate has passed a bill moving up the sale of the first $10,000,000 state road bonds to Jan. 1, 1922. Address State Engr.

Bryson City, N. C.—Swain Co. has voted $100,000 road bonds for use in Forney's Creek twp. Address Twp. Clk.

Akron, O.—Summit Co. has voted $252,000 road bonds. Address Co. Aud.

Bellaire, O.—City has voted $80 000 street bonds. Address Clifford L. Belt, Chmn. of the Civic Division of the Chamber of Commerce.

Fremont, O.—City has voted $30,000 road bonds. Address City Aud. Clarence Pappenfuss.

Springfield, O.—The City Somn. has authorized the issuance of $40,000 street bonds. Address City Manager Parsons.

Ardmore, Okla.—Carter Co. has voted $500,000 road bonds. Address Co. Aud.

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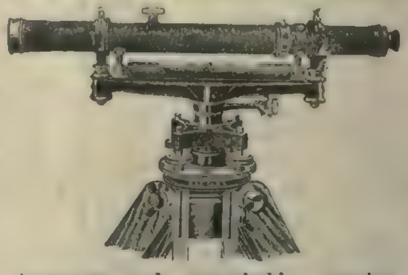

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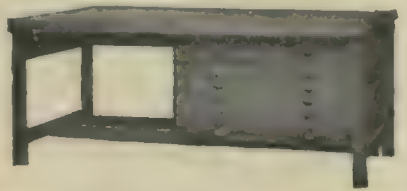

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Maps, plans, specifications and estimates may be seen and proposal forms obtained at the office of the Commission in Albany, N. Y., and also at the office of the division engineers in whose division the roads are to be improved or reconstructed. The addresses of the division engineers and the counties in which they are in charge will be furnished upon request.

The special attention of bidders is called to "General Information for Bidders" in the itemized proposal, specifications and contract agreement.

HERBERT S. SISSON,
Commissioner

J. C. FINCH,
Secretary

Bartlesville, Okla.—Washington Co. has voted $700,000 bonds for the construction of roads and bridges. Address Neva M. Scott, Co. Clk.

Mercer, Pa.—Mercer Co. has voted $1,300,000 road bonds.

Austin Tex.—The Attorney General's Dept. has approved an issue of $1,400,000 bonds for the purpose of road construction in Stephens Co.

Bryan, Tex.—Brazos Co., has voted $100,000 in bonds for the construction of bridges destroyed by flood. Address Co. Judge.

Vernon, Tex.—Wilbarger Co. has voted $600,000 of road bonds. Address Co. Aud.

Bushnell, Fla.—City plans to sell $30,000 of paving bonds. Address the mayor.

Fort Meade, Fla.—City plans to sell $30,000 of street paving bonds. Address N. J. Patterson, mayor.

Fort Meyers, Fla.—Lee Co. plans to issue $1,500,000 road bond issue. Address Co. Clk.

Lake Wales, Fla.—Bids will be received by city until Jan. 31 for the purchase of $200,000 of 6 per cent. street bonds. Address M. R. Anderson, mayor.

Plant City, Fla.—Bids will be received by city until Jan. 2 for the purchase of $20,000 of 6 per cent. paving bonds. Address W. H. Durrance, City Clk.

. **Tampa, Fla.**—Hillsboro Co. plans to issue $3,000,000 of road bonds. Address Co. Comrs.

Tavares, Fla.—Bids will be received by East Lake Co. until Dec. 28 for the purchase of $600,000 of 5 per cent. road and bridge bonds. Address T. C. Smith, Co. Clk.

Wauchula, Fla.—City will vote soon on proposed $70,000 street bond issue. Address the mayor.

Rome, Ga.—Floyd Co. sold $270,000 of road bonds to Robinson & Humphries Co., Atlanta, Ga., at par and accrued interest.

Oberlin, La.—Bids will be received by Allen Parish until Dec. 26 for the purchase of $60,000 of 5 per cent. road bonds. Address A. E. Darbonne, Clk., Police Jury.

Vicksburg, Miss.—Warren Co. will soon vote on $150,000 bridge bond issue.. Address Co. Clk.

Yazoo City, Miss.—Yazoo Co., Rd. District No. 5, will vote Dec. 29 on $25,000 road bond issue. Address Co. Clk.

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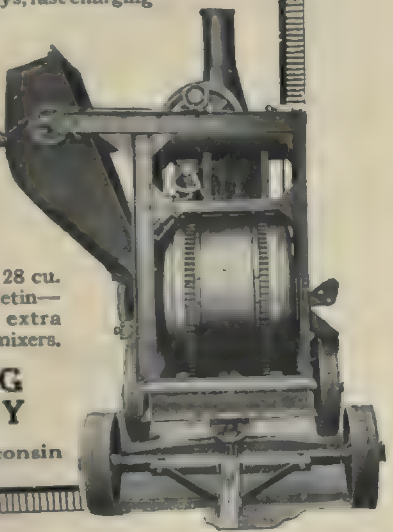

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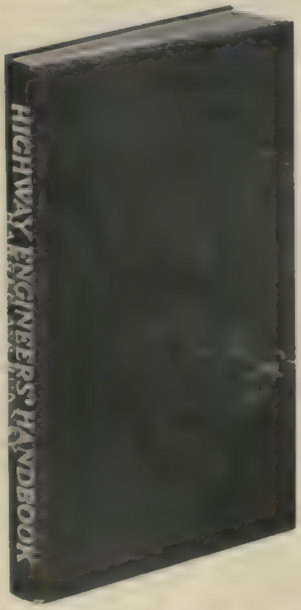

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